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FLIGHT
The AIRCRAFT ENGINEER

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The Outlook

About this Issue

NEVER before has Air Power loomed so large in international affairs. And never before has there been such widespread misconception of the relative air strength of the nations. The flatly contradictory reports flung at the public almost daily are in themselves evidence of the truth of that statement.

It is not to be wondered at, for secrecy is one of the chief gambits in the international game of beat-your-neighbour. The aspect that *is* surprising, however, is the amount of information that actually is available about the world's warplanes—to use a daily-paperish but convenient word. That information, of course, is not easily come by. It requires patient and expert technique to collect. That is why *Flight* is rather proud of this Special Number, which reviews in very considerable detail the trends in design of the more notable military products of all the aircraft-producing nations—and there are a surprising number of such nations.

We do not claim to reveal many "secrets," either about our own aircraft or those of other nations; but this issue does provide, in convenient form, a valuable index to the capabilities of machines now in service, or about to go into service.

It also emphasises the modern tendency towards specialisation of duties, and of the equipment to perform those duties. During the war of 1914-1918 an aeroplane was, primarily, either a fighter (misnamed a "scout") or a bomber, while reconnaissance duties were largely relegated to obsolete two-seat fighters. Nowadays, if we include marine aircraft (which were negligible in number during the last war), there are possibly a score of different classes designed and equipped for specific purposes. The soundness of such a policy under wartime production conditions has been questioned. Be that as it may, it does at least provide the interested observer with plenty of material for study; and to put that material in a most conveniently assimilable form is the purpose of this issue of *Flight*.

Gorellation

IF every recommendation made by the Gorell Committee were adopted and enforced, there would still be people who would complain that the noise of aircraft engines irritated them and interfered with the so-called public amenities. The trouble is that a noise which irritates one person is not consciously heard by another. That being so, the mere establishment of standards of "maximum noise output" is not likely to be of much help. A loud noise which passes quickly is far less irritating to most people than a repeated noise the pitch and loudness of which varies in ordered sequence.

The case of Croydon Airport is quoted in the report as a particularly difficult one, and the committee comes to the conclusion that the interests of the local residents could not be adequately protected except by abandoning the site altogether. That, at any rate, is one recommendation with which all flying people will be in full agreement, although for different reasons. The report draws a touching picture of the way in which the value of property in the Croydon district has depreciated, and points out that 800 houses are for sale. It would be interesting to learn how many of those 800 houses were built and sold *since* Croydon has been an aerodrome. With the owners whose property was there before the aerodrome one has every sympathy. But it is less easy to shed a tear of commiseration for those who bought their houses years after the aerodrome was established.

When dealing with the safety of the general public the committee was faced with even greater difficulties. With the recommendation to prohibit all flying of single-engined aircraft above towns we fully agree, but it is going to be difficult to define what constitutes a town. If the lower limit is low enough, the effect will virtually be to rule out all single-engined aeroplanes. We do not say that this would necessarily be a bad thing. We merely call attention to the fact.

In the end the most useful of all the recommendations

of the report appears to be that which suggests that the problems of flying and the impossibility of eliminating *all* noise and *all* low flying should be made more widely known to the general public.

"An Important Contribution"

FOR a number of years it has been an ambition of Australia to develop a native aircraft industry, but for some time the idea was hampered by the shortage of skilled labour in the country, by the high cost of what labour there was, and to some extent by the natural desire of manufacturers in Britain to sell completed machines to Australia rather than to arrange for them to be built on the spot.

What seemed to be something like an impasse has been cleared away by the Home rearmament policy and by the international situation. Britain is no longer the rival who keeps Australia from achieving her ambition; she has become the helper who has made its fulfilment possible. The Hardman Lever mission has arranged for the development of Australian aircraft manufacture. The machines to be built in Australia are to be of British design, which is an important point for both the R.A.A.F. and the R.A.F. We rejoice at the thought of the employment and prosperity which this scheme will bring to the Commonwealth, and likewise because the tendency to look for help to America rather than to the Homeland, which had been noticed in Australia of late, is certain to wane. Above all, the air forces of the Empire will be in a stronger position as a result of this agreement. It is, as Sir Kingsley Wood said, "an important contribution to Empire defence."

Stratospherics

HITHERTO it has usually been claimed that the saving in fuel obtained by flying high is only of real importance on very long flights. The Fairey engineers do not appear to share that view, and estimate in a recently issued announcement that even on a flight of 1,000 miles the saving will amount to something like 500 lb. This appears somewhat surprising until one discovers that certain assumptions are made in connection with the climb to and descent from the operational height (15,000 ft.).

Taking the maximum permissible rate of change of height of a non-airtight cabin machine as 300 ft./min., and the airspeed as 200 m.p.h., the Fairey engineers arrive at the result that 1 hour 40 minutes is spent in climbing and coming down, during which time the machine would cover 330 miles of the 1,000. With its airtight cabin the Fairey F.C.1 will be able to cover 80 per cent. of the journey at 15,000 ft. and will spend 30 minutes only in changing height.

The argument appears slightly faulty in that it assumes that the maximum rate of climb which passengers in an ordinary cabin can stand without discomfort is 300 ft./min. Actually a rapid rate of pressure decrease is not nearly so distressing as the same rate of pressure increase.

But as *Flight* has long argued, it will not be the gain in fuel consumption or in cruising speed at altitude which will force operators to adopt the pressure cabin. It will be the demand of the passengers for protection of their ear drums. And the F.C.1 should certainly give that, and also an ample supply of fresh air, as the cabin superchargers are being designed to deliver 20 cu. ft. of air per passenger every minute. The two pumps will be driven by two of the engines, and even if one engine stops, the air supply will still be 10 cu. ft. per minute per passenger, which is sufficient in all normal circumstances.

The Headache Race

PRELIMINARY regulations for the 1939 King's Cup Race have now been issued by the Royal Aero Club. They disclose a fact which was not mentioned in the announcement about the race published in last week's Royal Aero Club Notices, i.e., that the race is confined to civil aircraft.

Thus the "unlimited" engine power does not really amount to very much, as the scarcity of commercial aeroplanes is such at present that it is very unlikely that many high-powered ones can be spared from their work of earning bread and subsidy butter. A few normally kept as stand-byes will probably be entered in the hope that their services will not be required on the routes on the day of the race.

As a spectacle the race will probably be well worth watching, but to follow details of re-handicapping and penalising will be a task beyond the average onlooker. Probably, however, that does not greatly matter.

The system of awarding points and of re-handicapping after each section appears fairly sound. How it will work in practice remains to be seen. It would seem that if one competitor is sufficiently faster than the handicapper thinks he is, it will, theoretically, be possible for him to improve his speed by exactly 5 m.p.h. in each section and so gain the full 20 points, but it seems equally possible to visualise the case of the "first man home" not necessarily being the winner. If that were so, the whole scheme will have defeated its own object, for after all, the reason, and the only reason, for re-handicapping after each section is to ensure a close finish. But a close finish in which the second or third man home is the winner is useless.

The "Cavalier" Report

AT the time when the Imperial Airways boat *Cavalier* was forced down when flying between Port Washington, New York and Bermuda, the American Press was, to say the least of it, extremely critical and even bitter in its comments. The accident, in fact, gave the papers concerned just the opportunity they required for attacking British commercial aviation in general and, by contrast, providing a boost for American transport operation and, in particular, for that country's oceanic flying equipment.

Although some measure of blame can be attributed to the operators in this case for the fact that the boat was not equipped to deal with really extreme icing conditions (which were the prime cause of the catastrophe) the report clearly shows how dangerous it can be for lay journalists and others to jump to conclusions.

In the first place, a perfectly normal radio message explaining that it would be necessary to "earth" the aerial, was, not perhaps unnaturally, translated as a statement that the machine might have to be "landed" owing to bad weather, and the pilot was consequently criticised for continuing on his course. In the second place, the carburetter intakes were heated—but not adequately so for the very difficult conditions.

Just for once a transport accident has occurred in circumstances which have given everybody else connected with the business a chance to take advantage of the lessons to be learnt. All too often nowadays such accidents result in the complete destruction of the machine and in the loss of the lives of all those on board—so that those who are responsible for the resultant enquiry have little or no direct evidence on which to base their findings.

MILITARY AIRCRAFT of the WORLD

Their Functions, Characteristics and Possible Development

By H. F. KING

IN this review the author (who is also responsible for the companion articles on armament and power plants) examines, class by class, present-day practice in the design of military machines with reference to governing factors and indicated trends. Data are given in an inset table.

Regulations prevent the inclusion of data which would not only clarify certain points but would satisfy designers and others who know (if, indeed anyone knows) the inner workings of the official mind.

This review of types is split up into classes as follows:—

FIGHTERS pp. 307–311 BOMBERS pp. 312–314c
ARMY CO-OPERATION AND "ATTACK" pp. 314f–314j
OTHER TYPES . . . . . pp. 326–336

"*Flight*" photograph.

Armed, for the time being at least, with eight machine guns, the 335-m.p.h. Hawker Hurricane can alternatively be fitted with shell-firing armament.

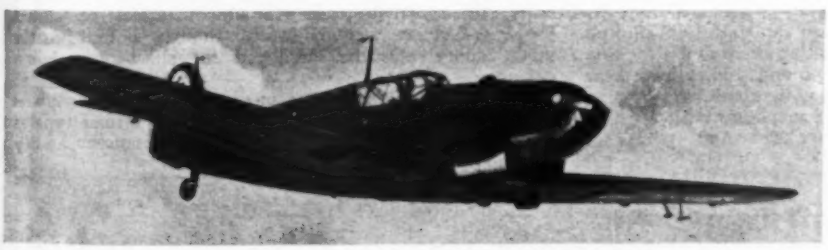
THE growing complexity of military aviation is introducing new terminology which may easily obscure, rather than clarify, a meaning. In order to avert the confusion which would inevitably result from the indiscriminate use of foreign expressions and terms the machines discussed hereafter are grouped under headings, the broad meaning of which should be understood by British readers.

It makes little difference whether a machine is called a pursuit ship or a chaser; it is still what we know as a fighter. Likewise an assault machine is meant for ground attack and a basic combat aircraft is an advanced fighter-trainer, while an observation machine corresponds essentially to our army co-operation class.

FIGHTERS

In Great Britain we have come to regard the fighting aeroplane almost exclusively as a weapon for home defence. That, certainly, is its primary rôle, but modern warfare calls for the fighter in a variety of guises.

The first-line single-seaters at present used by fighter squadrons of the R.A.F. are capable (assuming a rate of climb to 20,000ft. of 9 or 10 minutes) of engaging bombers while they are approaching, or after they have crossed,

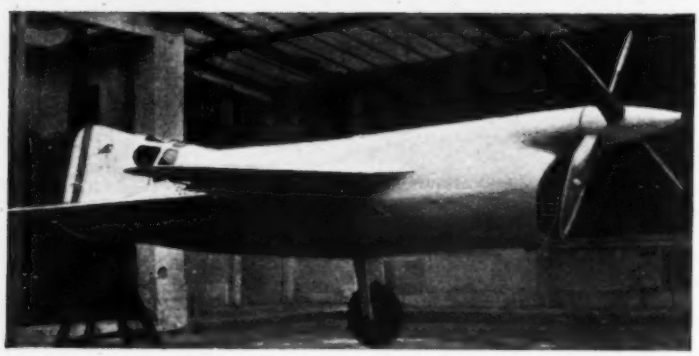


(Left) Performance figures for the Messerschmitt Me 109 (DB 600) have not yet been released.

(Below) The Supermarine Spitfire is believed to be the fastest fighter in large-scale production in the world. It does 362 m.p.h. with a Rolls-Royce Merlin II.

In small-scale production for the French Air Force, the Bloch 151 (left) is normally fitted with a Gnôme Rhône 14No, though a Twin Wasp is being tried experimentally. (Below) A fine example of the light fighter—the 450 h.p. Renault-engined Caudron Cyclone.

The upper of the two views below shows the Dewoitine D.520 which is said to lend itself well to rapid quantity production. A mock-up of the Payen *Flechair* shows (below) the extraordinary features of this twin-engined fighter. Retractable wing-tip skids are fitted.

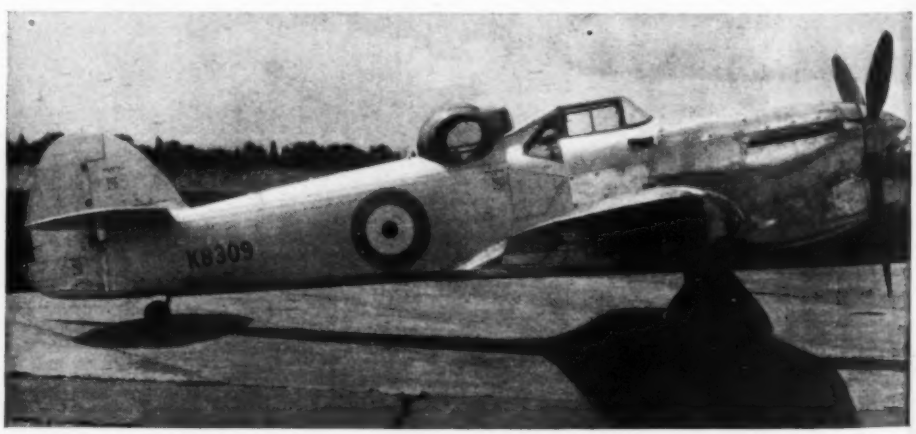


our coast, provided that due warning is received from external sources. Alternatively, they can patrol an allotted area and wait for the raiders, locating them and attacking on receipt of directions from the ground. They even bear comparison of climbing powers with specialised foreign "local defence intercepters," i.e., machines built specifically to defend crowded municipalities and points of great strategical importance, and so far as ease of maintenance and operation are concerned might, in the absence of a more specialised type, be used from advanced aerodromes to maintain superiority in the air and, in particular, to protect our army co operation machines. For defensive purposes they are to be supplemented by two-seaters with a battery of guns concentrated in a power-driven turret and suited for attacking and breaking up raiding formations.

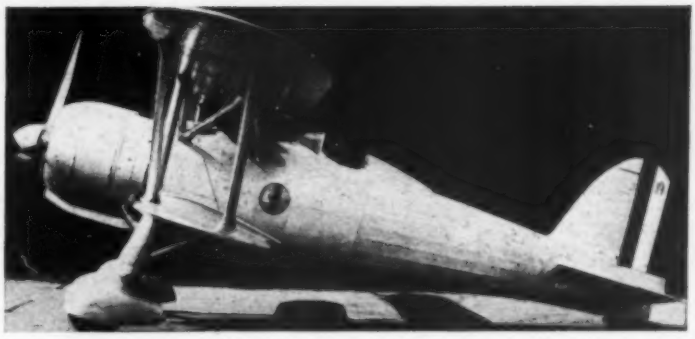
The range of these machines has not yet been revealed, but it is certain that they could not escort bombers on long-distance raids; nor could they engage long-range enemy formations before or shortly after the attackers left their bases. So we may see, before long, specialised fighters with sufficient tankage to undertake long-distance convoy work or alternatively to tackle enemy bombers over their "home ground." Obviously, they themselves would be closely akin to high-speed bombers or long-range ground attack machines.

Present-day fighters (including types in service and experimental models) may conveniently be classified, for purposes of discussion, single-seater single-engined; single-seater twin-engined; two-seater single-engined; two-seater twin-engined; three-seater twin-engined; and multi-seater twin-engined. The number of engines is not necessarily an indication of the fighter's duties. A twin-engined fighter, for example, may have a shorter range than a machine with only one power plant. A more positive clue will be the number of seats, for a single-seater will obviously not be suited for long-distance convoy work, though a multi-seater might conceivably be employed for short-range home defence.

Certainly the wing arrangement—biplane or monoplane—may aid in classifying a fighter, for the former type is mainly justified these days on grounds of manœuvrability



A highly developed two-seater fighter prototype is the Hawker Hotspur, which carries a battery of machine guns in a power-driven turret.



The Koolhoven FK 58 (Hispano Suiza 14AA of 1,100 h.p.) has been ordered in quantity by France.
The Fiat CR 42 represents the biplane formula and is said to be extremely manœuvrable.

or operation from confined spaces, though rate of climb and ceiling are other considerations. Extreme speed or range demand the monoplane.

It is usually assumed that a monoplane is less manœuvrable than the corresponding biplane. Categorically this is a correct assumption, but anyone who has seen demonstrations by Britain's new monoplane fighters will realise that these are not the intractable projectiles they are sometimes alleged to be.

Typically, the single-seater single-engined fighter of to-day is a low or mid-wing cantilever monoplane tractor type. Structurally it may be all wood, wood and metal, metal with fabric covering, or metal with sheet metal covering. The wooden, or partly wooden, types are mainly in the inexpensive low-powered class and though, as we shall see, certain designers are making attractive claims for aircraft of this description, the high-powered metal machine is dominant.

Aerodynamic design is greatly influenced by military requirements. By way of example the wings of fighters, although usually of the common tapering variety, often exhibit peculiarities for reasons of view, control, stability or ease of maintenance.

Although of comparatively small size, the single-seater makes use all the aids to performance which feature in much larger aircraft. The variable-pitch airscrew is now almost a *sine qua non*, although the first batches of Supermarine Spitfires and Hawker Hurricanes delivered to the R.A.F. had wooden fixed-pitch screws, depending upon the large reserve of power provided by the Rolls-Royce Merlin engine to give reasonable take-off characteristics. Airscrews giving a wide pitch range are, of course, being favoured, partly because of their capacity for holding down engine speed in a dive, as demonstrated a few weeks back by an American Curtiss P.36 fitted with a Curtiss electrically controlled fully feathering airscrew. This machine was dived from 22,000ft. up to a speed in the region of 575 m.p.h. and never did its Pratt and Whitney Twin Wasp engine exceed the makers' limiting r.p.m. Reversible-pitch airscrews, which give a braking effect, have so far been applied mainly to dive bombers.

Flaps, of course, are essential to steepen the gliding angle of a clean fighter. In some cases, these benefit take-off and in rarer instances they can also be used to limit diving speed. Flaps such as these must, of course, be exceptionally sturdy to withstand the heavy stresses.

Despite the fact that the Handley Page automatic slot is a British invention, the first practical application of this aid to a fighter has been made in the German B.F.W. (Messerschmitt) 109, a well-established service type.

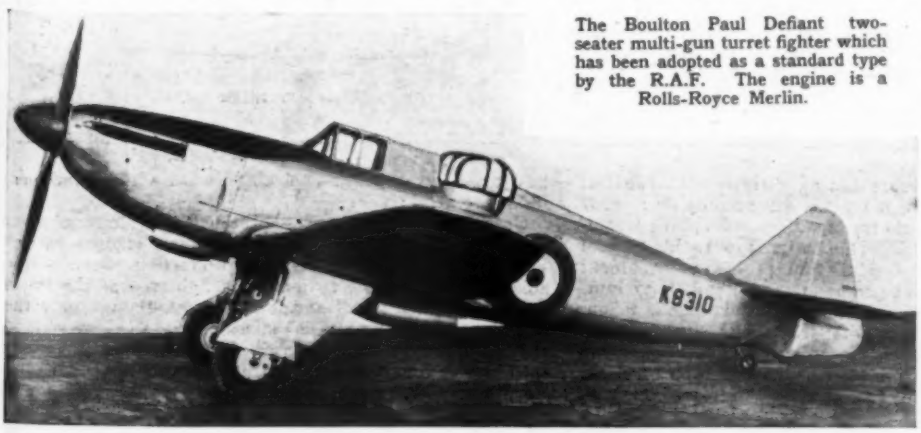
Smoothness of surface, of course, is of tremendous importance at speeds over 300 m.p.h., and though some fighters are beautiful examples of flush riveting they are often handicapped, like other Service types, by the rough non-reflecting camouflage.

Inferior vision is one strong argument against the conventional single-engined tractor fighter. Some years ago, when bracing struts could be countenanced, a number of designers adopted the high, gull-wing arrangement, using a tapering centre section of very small area and placing the cockpit behind the wing.

Others produced pusher machines and, indeed, both the German Focke Wulf and the American Bell concerns are said to be developing single-engined pusher fighters, though the reason for this step is probably linked with armament rather than vision.

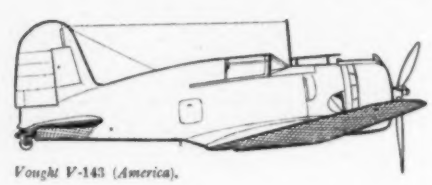
The Curtiss concern has tried placing the pilot in a cabin under the leading edge. Westlands, with a biplane, likewise put the pilot well forward, using a shaft drive from a Rolls-Royce Goshawk engine. Blackburns, in the past, also built a "clear-vision" biplane though no one reverted to back stagger for the wings, despite the success of the American Beechcraft on the civil market. Mr. Fritz Koolhoven with his single-engined, twin-airscrew, shaft drive, tractor fighter has placed the pilot well forward.

Improved vision almost inevitably spells inferior performance in a modern single-engined single-seater fighter, with the result that to-day the pilots of some of the fastest fighters are well behind the wing

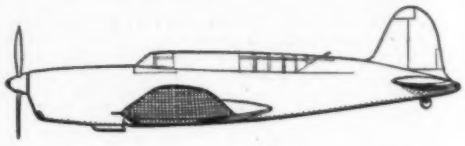


The Boulton Paul Defiant two-seater multi-gun turret fighter which has been adopted as a standard type by the R.A.F. The engine is a Rolls-Royce Merlin.

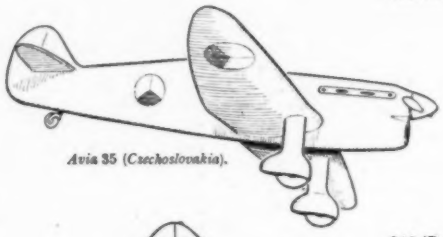
VARIETY in the DESIGN of FIGHTERS



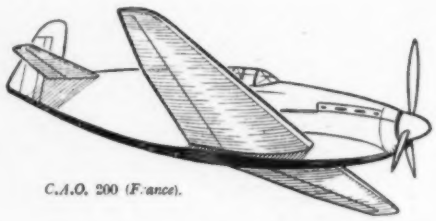
Vought V-143 (America).



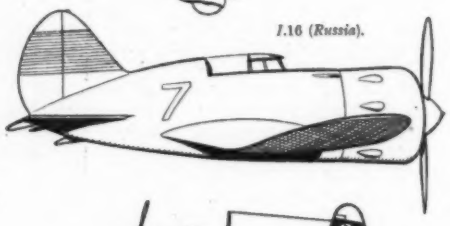
S.A.B.C.A. S.74. (Belgium).



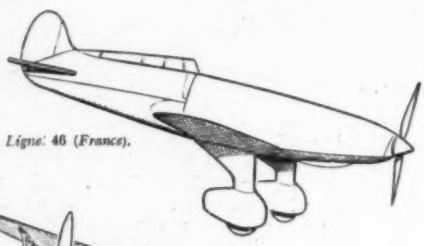
Avia 35 (Czechoslovakia).



C.A.O. 200 (France).

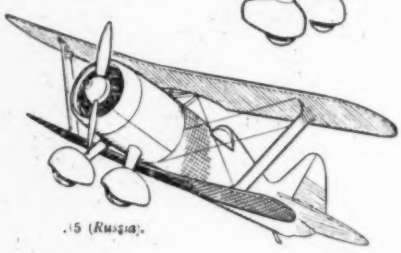


I.16 (Russia).

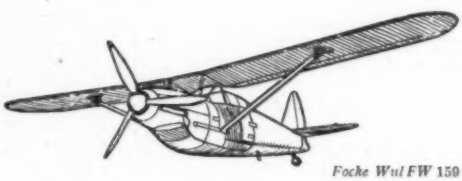


Ligne 46 (France).

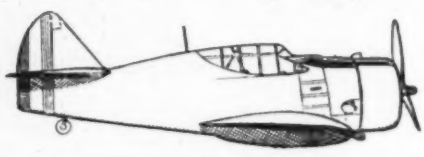
Arado 80 (Germany).



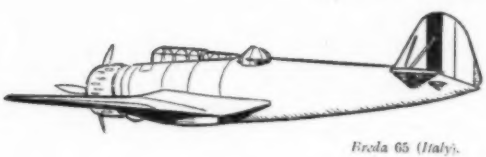
I-5 (Russia).



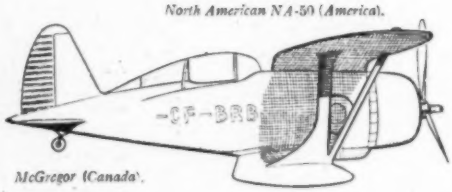
Focke Wulf FW 159 (Germany).



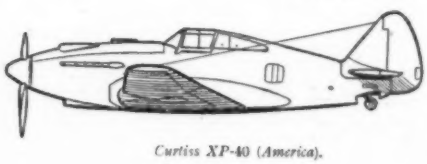
North American NA-50 (America).



Breda 65 (Italy).



McGregor (Canada).



Curtiss XP-40 (America).

with the cockpit enclosure fairing directly into the fin.

Twin-engined fighters, it seems, will become *de rigueur* for various duties—mainly for breaking up bombing formations and for escort work. Due to its layout, this type of machine facilitates the installation of heavy armament (either a battery of 20-23 mm. guns, or, say, a 37 mm. weapon) and, moreover, provided full advantage is taken, improves forward vision in comparison with single-engined types. Little information regarding the development in Great Britain of this class of machine has been released. It is known, however, that pilots are being trained on twin-engined types and in this connection the Bristol Blenheim has many good points—speed, forward vision, and performance at altitude.

Germany is believed to have the B.F.W. (Messerschmitt) 110 fitted with two Daimler-Benz DB601 engines on service test, if not in large-scale production. France—the spiritual home of the twin-engined fighter—has the Potez 63, Breguet 690 and Hanriot 220 types, though only the Hanriot—a two-seater—is considered as a specialised fighter. The Italian Breda 88 fighter-bomber is coming into service and is claimed to have a very high performance with two Piaggio radials.

The machines named are all tractor types, with engines

The French Hanriot H-220 two-seater fighter is claimed to have a speed well in excess of 300 m.p.h. It is in production.

A multi-purpose type which can function as a two- or three-seater fighter is the Potez 63 (centre right).

Certainly one of the fastest fighting aircraft in the world this Allison-engined Lockheed (lower right), was crashed a few weeks ago.

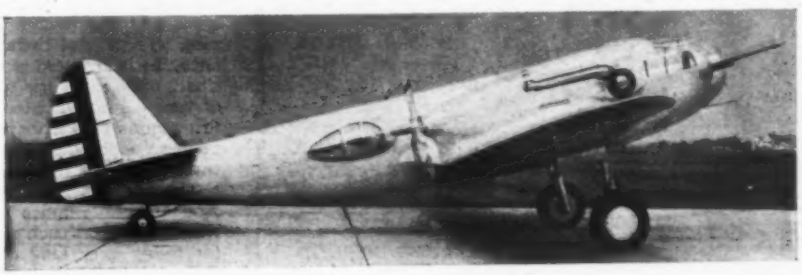
forward of the leading edge of the monoplane wing. Fokker has departed from this layout in his D.23 (two Walter Sagitta) by adopting twin tail booms (as in the older G.1) and placing his engines in tandem with the pilot between them. The D.23 is armed with two 13.2 mm F.N.-Brownings firing explosive bullets and two rifle-bore machine guns. Eventually a machine of this type, but with two Daimler-Benz DB-600s or Rolls-Royce Merlins is likely to be developed. Armour plating is fitted to the front and rear of the pilot's seat. The engines provide further protection.

Even more unorthodox is the little Payen *Flechair* (Pa. 112) now being built in France. In the prototype of this somewhat bizarre-looking machine two Salmson engines of 100 h.p. each are fitted, driving, by means of "electrical coupling" counter-co-axial revolving airscrews. Two 7 mm. machine guns and one 23 mm. Madsen shell-gun are specified, though a Payen compressed-air gun (37 mm.) is visualised.

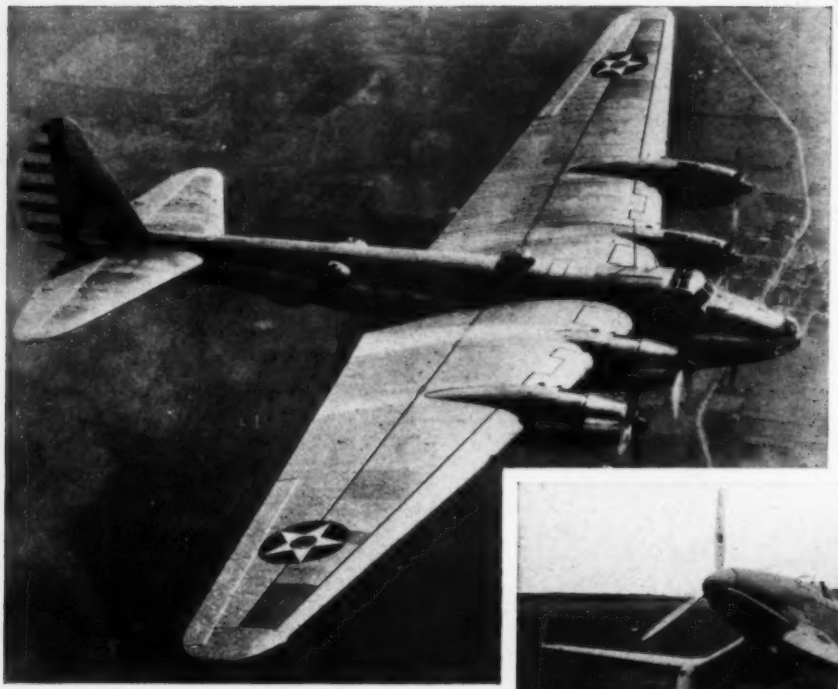
Another departure (though resembling the Fokker G.1 in lay-out) is the American Allison-engined Lockheed, said to do nearly 400 m.p.h. This prototype has been crashed and development work is likely to be somewhat impeded.

Largest and most heavily armed of the twin-engined multi-seater fighters on test to-day is the Bell Airacuda, which has two liquid-cooled Allison engines driving pusher propellers and fitted with exhaust-driven superchargers. Thirteen examples have been ordered for the U.S. Army Air Corps. The pusher arrangement has enabled two gunners, each provided with a large-bore shell-gun, to be accommodated in the noses of the nacelles, the guns having a limited range of movement. Three machine guns, carried in streamlined "blisters," form the auxiliary armament.

The development of fighting aircraft during the next five years should be exceptionally interesting. It is unlikely that the single-engined single-seater will disappear for some time, for the use of co-axial airscrews should permit the installation of engines of 1,700-2,000 h.p. Machines thus powered should be able to carry at least four shell-guns of 20-23 mm. bore, or, on the basis of eight machine guns for the Hurricane and Spitfire, twelve of these small weapons. There is one argument which, however, must not be ignored: if a machine will do 400 m.p.h. with an engine of, say, 1,700 h.p., an aircraft with two similar power plants will go even faster. The cost of squadrons of these big fighters, however, hardly bears contemplation. An opposing school demands lighter, simpler, cheaper, lower-powered fighters for localised defence, developed along the lines of the Caudron Cyclone (450 h.p.), which, although slower by 20-70 m.p.h. than machines with 800-1,000 h.p., picks up speed very quickly in a dive.



Two shell-guns and three machine guns form the armament of the Allison-engined five-seater Bell pusher fighter

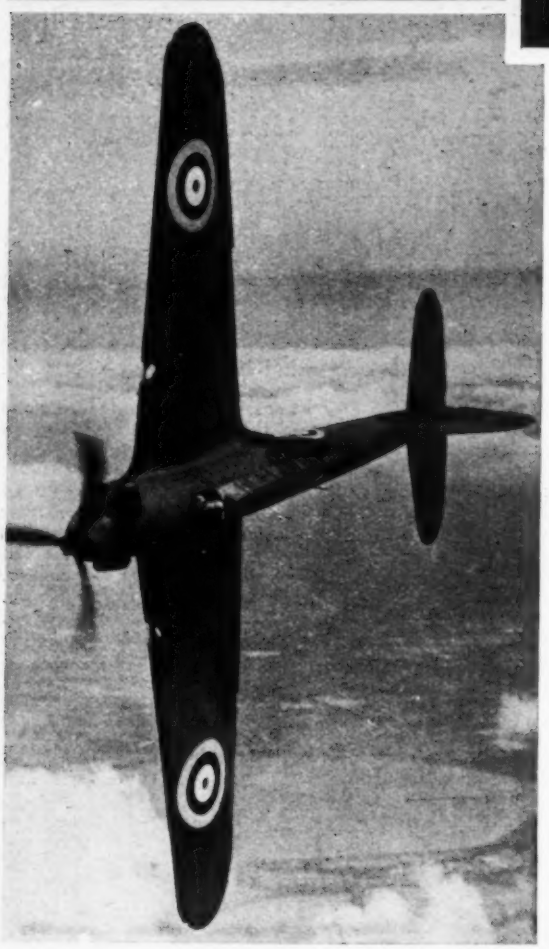


(Left) The world's largest bomber: The Boeing XB-15 which is even bigger than the B-17s already in service. At the moment it has four Twin Wasps but obviously could do with engines even more powerful.

"Flight" photograph.

(Bottom left) A fine example of the single-engined bomber: The Fairey Battle with Rolls-Royce Merlin II engine. Hundreds are in service.

The little Blohm and Voss Ha 137 with Junkers Jumo 210 engine is a single-seater dive bomber with flaps to reduce its diving speed.



Military Aircraft—II

BOMBERS

THE design of bombing aircraft to-day is as diversified as that of fighters. Modern types range from single-seater dive bombers (650-800 h.p.) to long-range four-engined machines of more than 5,500 h.p. by way of two three-seater single-engined types (600-1,200 h.p.), twin-engined models (700 h.p.-2,200 h.p.), and certain three-engined machines from 2,250 to 3,000 h.p.

Before discussing the factors influencing layout, size, power and performance, we must first lay down some minimum requirements.

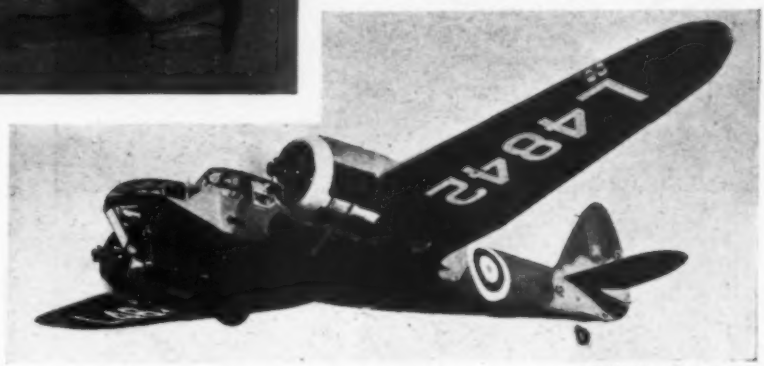
Bomb load may be considered as a function of range. These two factors actually give the index to military efficiency, assuming, of course, that the machine is adequately protected against attack by fighters.

The terms "long," "medium," and "short" range as applied to bombers are purely relative. There are machines in service to-day that are generally classed as medium bombers which carry a bigger bomb load for a much greater distance than the "heavies" of four or five years ago. According to present theories there is work for small tactical bombers as typified by the single-engined types and the lighter twin-engined machines now in service. These, due to their limited range and high performance, have inspired a theory that all bombers should be small, agile machines with armament corresponding to that of twin-engined fighters, i.e., fixed or semi-fixed forward-firing guns plus armament with a restricted arc of movement as opposed to so-called "flying fortresses" with their turrets and arrangements of broadside fire.

The question is: Can we build bombers with a range of 2,000 or more miles carrying a worth-while bomb load which will meet such requirements? The only justification for flying very long distances is to strike a telling blow. This can be achieved either with a large number of machines

(Left) Although employed by the R.A.F. on target-towing duties, the Hawker Henley is one of the world's finest single-engined bombers.

(Below) Outstanding among the world's high-speed bombers is the latest version of the Bristol Blenheim which does 295 m.p.h. and has a range of 1,900 miles.



"Flight" photographs.

carrying a comparatively small bomb load or a few bigger, heavier machines—for extreme range and bomb load inevitably mean bulk and sluggishness. It is frequently argued that these big machines represent "too many eggs in one basket." The same might be said of the Navy's battleships. If an aircraft is doing a worthwhile job it is worth staking manpower and equipment. By all means size should be kept down, but to argue that bombers should be "small" is no more reasonable than suggesting that destroyers should carry 16in. guns.

The only telling argument against really big bombers is that they are unable adequately to defend themselves. Unlike the large flying boats they can rarely adopt low-flying tactics to prevent fighters from attacking from below. They must fight as they fly to and from their objective or rely upon the protection of long-range escort fighters. Once these fighters broke formation they would be laying their charges open to further attack. This means the provision of turreted armament—and there we have the whole crux of the matter. If the value of turrets is proved the big bomber may be justified.

In any case, the air forces of the world are said to be ordering big four-engined bombers in quantities, and after a considerable period of experiment are still developing power-driven gun turrets, so that we will assume that there is a place in the scheme of things for the large, as well as the small, bomber. Let us now consider in order of size the lines on which the various classes are developing.

The smallest bombers possessed by any of the world's air forces to-day are specialised machines developed for the German Air Force. These are exemplified by the Blohm and Voss Ha 137 and the Henschel 123, and are closely related to single-seater fighters. They have been developed specifically to deliver diving attacks.

Despite the scepticism which has been expressed as to the value or practicability of this type of attack, it is a fact that many of the smaller types of bombers to-day are being designed with a view to their use, if required, as dive bombers. Special air brakes are being fitted to limit the diving speed or reversible-pitch airscrews are being introduced to give the same effect.

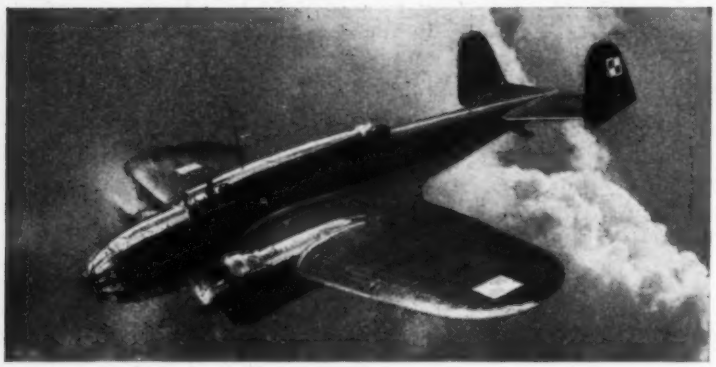
Taking the Junkers Ju.87 as a typical two-seater dive bomber of the German Air Force we find that, like the little Blohm and Voss already mentioned, it has "cranked" wings of broad "W" formation, a fixed undercarriage, and an inverted-vee Junkers liquid-cooled engine—actually the 1,000 h.p. petrol-injection Jumo 211.

When a single large bomb (1,100 lb.) is carried it is suspended behind the radiator housing, the machine being provided with special displacement gear to guide the projectile clear of the airscrew.

The air brakes take the form of long slats behind the leading edge of the wing on the under surface. Before entering his bombing dive the pilot turns them broadside on to the airstream, and is probably able to limit his speed to something like 240 m.p.h.

Dive bombing is a designed function of our Fairey Battle and P.4/34 types, and for that matter of the Hawker Henley, despite the fact that this excellent machine is being used in the R.A.F. for high-speed target towing. Special sights have been developed for this form of attack, and dive bomber squadrons are trained in the art of deceiving enemy anti-aircraft gunners, often making their dives in steps, or corkscrewing on their way down to the target. The low-flying attack is, of course, an alternative method, while high-altitude "precision" bombing, using a bomb

A standard dive bomber of the German Air Force is the Junkers Ju. 87 (top right) with Jumo 211 engine. Under the wing are flaps to reduce the diving speed. Below is seen the Czech Letov S.231, a bomber corresponding to the Blenheim formula. It has the same power plant—two Bristol Mercury VIIIs.



One of the best Continental bombers in production to-day is the Polish P.Z.L. Los with two Bristol Pegasus engines. The low aspect ratio of the wing is a notable feature. The lower picture is a nose view of the German Dornier Do.17 showing the installation of its Daimler Benz DB 600 engines, which confer a very good performance.

sight, is still practised assiduously by R.A.F. squadrons armed with single-engined bombers.

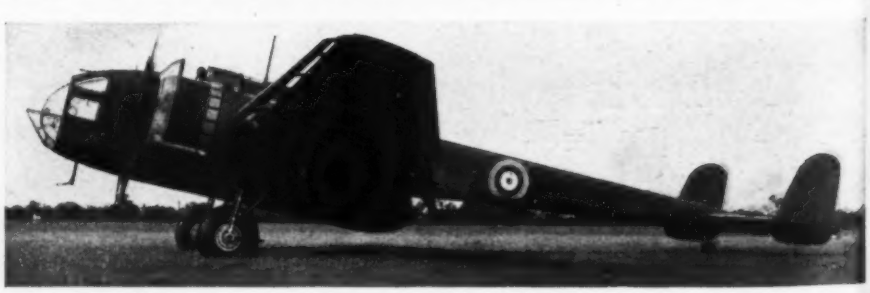
Dive bombing can also be undertaken by certain twin-engined types, notably the Fokker G.1 (*Faucheur*), which, like the Junkers already mentioned, has diving brakes under the wings. The G.1, when powered with a pair of fully supercharged Bristol Perseus sleeve-valve engines, attains a maximum speed of about 300 m.p.h., and carries a useful load of 3,580 lb. as a bomber for a range of 935 miles.

Peerless among the standard machines in this class is the Bristol Blenheim, which in its latest form is capable of carrying a useful bomb load for 1,900 miles. The top speed is 295 m.p.h. A crew of three is carried and two machine guns—one fixed and one free, are specified. A corresponding type in the German Air Force is the Dornier Do17, which is commonly fitted, these days, with liquid-cooled Daimler Benz DB 600 inverted-vee engines of about 1,000 h.p. each. Bombers built to this formula have proved their worth on active service in Spain, and go far toward meeting the requirements of the protagonists of the extremely fast bomber suited to take axial (as opposed to freely movable) armament, though the Blenheim has a power-driven gun-turret which is anathema to this school of thought.

Heavier military load, more elaborate defensive armament, and longer range characterise the next size in bombers as represented by the geodetic-built Vickers Wellington, which incidentally can be powered with Bristol Pegasus, Rolls-Royce Merlin, or Bristol Hercules engines; the Handley Page Hampden (characterised by its lean, efficient-looking profile designed to provide wide fields of fire); and the German Heinkel He 111K, a shapely development of a civil type.

While some nations favour power-driven armament for such machines, others, like Germany, rely on guns with restricted arcs of movement for defensive purposes. Shell guns are being mounted in some of the more modern machines under discussion, notably the sleek French Amiot 340, which will, incidentally, be fitted before long with two-speed supercharged Rolls-Royce Merlins, and the LeO 45, destined shortly to receive a pair of sleeve-valve Hercules.

An ultra-modern and outstandingly interesting high-powered twin-engined bomber, about which very little information is obtainable, is the high-wing Douglas B-19 as ordered by France. The prototype of this machine met with a tragic accident while carrying an officer of the French Air Force, who was visiting the U.S.A. in connection with the purchase of a batch of B-19s. Features of this aircraft are a tricycle undercarriage, two of the very latest two-row American radials, and a power-driven gun-turret.



Adopted as a standard type by the French Air Force, the Amiot 340 is one of the best looking of modern twin-engined bombers. It has two Gnome Rhone N 14 engines.

(Lower picture) Well defended and able to carry a heavy load at high speed, the Handley Page Hampden, in production for the R.A.A.F., is a brilliant example of the modern twin-engined bomber.

MILITA

IMPORTANT NOTICE:

This table has been prepared to indicate the characteristics o recent military aircraft produced in this country and abroad. been gleaned from a variety of sources, and absolute accuracy ca The majority, however, is based on manufacturers' data.

It should be realised that figures for "cruising speed" and "

Maker (and Country)	Designation of Aircraft	Duties	No. of Crew	Construction	Span	Engine(s)	No. of Engines	Gross Weight	Disposable Load	Max. Power	Max. Power Alt.	Max. Speed	Cruising Speed	Ceiling	Normal Range	Armament	Progress
					ft. in.			lb.	lb.	h.p.	ft.	m.p.h.	m.p.h	ft.	miles		
GREAT BRITAIN																	
Boulton Paul	Defiant	F	2	M	39 6	RR Mer	1	—	—	1,030	16,250	—	—	—	—	rcmg	IP
Gloster	Gladiator	F	1	MF	32 3	Br Merc IX	1	4,750	1,465	840	14,000	255	—	35,000	—	4 rcmg	IP
Hawker	Hotspur	F	2	MF	40 6	RR Mer	1	—	—	1,030	16,250	—	—	—	—	rcmg	Ex
Hawker	Hurricane I	F	1	MF	40 5	RR Mer II	1	6,000	—	1,030	16,250	335	275	35,000	600	8 rcmg	IP
Supermarine	Spitfire I	F	1	M	36 10	RR Mer II	1	—	—	1,030	16,250	362	—	—	—	8 rcmg	IP
Blackburn	Skua I	FB*	2	M	46 2	Br Per	1	—	—	900	—	—	—	—	—	rcmg	IP
Fairey	P.4/34	FB	2	M	47 4½	RR Mer II	1	—	—	1,030	16,250	283	—	—	—	8 rcmg	IP
Armstrong-Whitw'th	Whitley III	B	5	M	84 0	As Tig VIII	2	24,000	7,750	1,564	15,000	215	177	23,500	1,315	rcmg	IP
Armstrong-Whitw'th	Whitley IV	B	5	M	84 0	RR Mer IV	2	25,000	—	—	—	245	220	25,000	—	rcmg	IP
Bristol	Blenheim	B	3	M	56 4	Br Merc VIII	2	12,030	4,621	1,680	14,000	285	250	29,000	1,125	2 rcmg	IP
Fairey	Battle	B	2-3	M	54 0	RR Mer II	1	10,792	4,145	1,030	16,250	257	—	—	1,000	2 rcmg	IP
Handley Page	Hampden	B	3	M	69 4	Br Peg	2	—	—	2,000	—	—	—	—	—	rcmg	IP
†	Hereford	B	3	M	69 4	Nap Dag	2	—	—	2,000	—	—	—	—	—	rcmg	IP
Hawker	Henley	B	2	MF	47 10½	RR Mer II	1	—	—	1,030	16,250	272	235	29,000	950	2 rcmg	IP
Vickers	Wellesley	B	2	MF	74 7	Br Peg XVIII	1	11,100	4,731	885	15,500	228	—	35,250	1,210	2 rcmg	OP
Vickers	Wellington I	B	4-7	MF	86 1	Br Peg	2	—	—	2,000	—	—	—	—	—	rcmg	IP
‡	Bombay	B Tp	3-4	M	96 0	Br Peg	2	—	—	2,000	—	—	—	—	—	rcmg	IP
Saunders-Roe	London (F.B.)	RB	5-6	MF	80 0	Br Peg X	1	18,400	7,300	1,830	6,250	155	137	21,000	1,000	3 rcmg	OP
Short	Sunderland1 (F.B)	RB	6-8	M	112 9½	Br Peg XXII	4	45,700	17,410	3,660	6,250	210	178	22,000	1,670	7 rcmg	IP
Supermarine	Stranraer (F.B.)	RB	5-6	MF	85 0	Br Peg X	2	19,000	7,750	1,830	6,250	165	—	18,500	1,000	3 rcmg	OP
Westland	Lysander I	AC	2	MF	50 0	Br Mer XII	1	5,920	1,855	890	6,000	229	150	27,000	600	3 rcmg	IP
Avro	Anson	R Tr	3	WMF	53 4	AS Che IX	2	7,663	2,713	700	7,300	188	158	21,000	—	2 rcmg	IP
Blackburn	Shark II	TSR*	2-3	MF	46 0	AS Tig VI	1	8,013	3,831	810	6,400	152	—	17,500	575	2 rcmg	OP
Fairey	Swordfish	TSR*	2-3	MF	45 6	Br Peg III	1	7,720	3,525	750	4,750	154	131	20,250	—	2 rcmg	IP
Supermarine	Walrus (Amphib)	SR*	3	MF	45 10	Br Peg VI	1	7,200	2,300	680	3,500	135	95	19,500	600	2 rcmg	IP
Fairey	Sea Fox	R	2	MF	40 0	Nap Rap VI	1	5,420	1,615	395	6,000	124	106	12,000	440	1 rcmg	IP
Airspeed	Oxford	Tr	3	W	53 4	AS Che X	2	7,500	2,178	710	7,000	192	166	24,800	860	1 rcmg	IP
Avro	626	Tr	2	MF	34 0	AS Che V A	1	3,000	872	302	SL.	130	108	17,500	470	2 rcmg	OP
De Havilland	Tiger Moth	Tr	2	WMF	29 4	DH Gip Maj	1	1,825	710	130	SL.	109	94	16,000	458	—	IP
Heston	Trainer	Tr	2	W	—	DH Gip Six	1	—	—	200	SL.	—	125	—	375	—	Ex
Parnall	382 Trainer	Tr	2	W	32 6	DH Gip Six	1	2,450	795	200	SL.	155	135	—	—	—	Ex
Percival	Trainer	Tr	2	W	36 0	DH Gip Six	1	2,500	790	200	SL.	158	143	17,000	580	—	AO
Percival	Trainer	Tr	2	W	36 0	DH Gip Six II	1	2,500	—	205	SL.	163	150	19,500	600	—	AO
Phillips and Powis	Magister	Tr	2	W	33 10	DH Gip Maj	1	1,825	660	130	SL.	145	125	22,000	400	—	IP
Phillips and Powis	Master	Tr	2	W	39 0	RR Kes XXX	1	—	—	—	—	268	226	29,000	440	1 rcmg	IP
De Havilland	Dion	Comm	2-3	W	47 6	D.H. Gip King	1	6,530	—	425	7,750	213	192	—	890	—	IP
Airspeed	Queen Wasp	Tar	—	WF	31 0	AS Che	1	—	—	355	—	—	—	—	—	—	Ex
U.S.A.																	
Bell	XFM-1 (Airacuda)	F	5	M	—	All V-1710	2	—	—	2,100	—	300+	—	30,000+	—	4 rcmg 2 ag	Ex
Curtiss-Wright	Hawk 75	F	1	M	37 4	Wr Cy G	1	5,172	1,188	840	10,700	280	240	32,500	—	1 lbmg 3 rcmg	IP
Curtiss-Wright	Hawk 75A	F	1	M	37 4	Wr Cy G	1	5,692	1,209	860	10,500	302	260	34,300	677	1 lbmg 3 rcmg	IP
Curtiss-Wright	Hawk IV	F	1	MF	31 5	Wr Cy F-56	1	4,598	1,194	745	12,500	248	211	30,500	—	1 lbmg 1 rcmg	OP
Curtiss-Wright	21 Interceptor	F	1	M	35 0	Wr Cy G	1	4,250	1,200	850	6,000	287	275	37,000	—	1 lbmg 1 rcmg	IP
Grumman	F3F-1	F*	1	MF	32 0	PW Wa Jr	1	4,100	1,230	650	7,500	240	215	30,000	720	1 lbmg 1 rcmg	IP
Grumman	FF-1	F*	2	MF	34 6	Wr Cy F	1	4,800	1,579	775	5,800	220	200	26,500	647	3 rcmg	AO
Grumman	G-37	F	1	MF	32 0	Wr Cy G	1	4,620	1,370	750	15,200	270	224	33,000	—	1 lbmg 1 rcmg	IP
North American	NA-50	F	2	MF	37 0	Wr Cy G	1	5,400	1,236	840	8,700	260	231	31,000	—	2 rcmg	AO
Seversky	EP-1 (Model 100)	F	1	M	36 0	PW Tw Wa	1	5,730	1,320	950	14,300	320	290	32,500	750	1 rcmg 1 lbmg	AO
Seversky	2 PA (Model 200)	F	2	M	36 0	PW Tw Wa	1	6,022	1,576	950	14,300	315	285	31,500	675	2 rcmg 1 lbmg	AO
Seversky	2PA-A(Model 230)	F	2	M	41 0	Wr Cy G-2	1	6,687	1,896	850	5,800	225	200	24,500	900	2-3 rcmg	AO
Vought	V-143	F	2	M	33 6	PW Tw Wa Jr	1	4,370	964	750	9,000	300	—	31,500	951	2 rcmg	AO
Brewster	138	BF*	2	M	39 0	Wr Cy G	1	—	—	750	15,200	—	—	—	—	3 rcmg	AO
Curtiss-Wright	19-R	A	2	M	35 0	Wr Wh	1	3,200	1,193	420	1,400	209	190	23,000	—	3 rcmg	AO
Curtiss-Wright	76-D	A	2	M	59 6	Wr Cy G	2	12,793	3,405	1,680	8,700	266	224	31,500	—	5 rcmg	AO
Curtiss-Wright	Shrike	A	2	M	44 0	Wr Cy F	1	5,925	1,901	775	5,800	206	171	21,500	455	5 rcmg	OP
Douglas (Northrop)	8-A	A	2	M	47 9	PW Tw Wa Jr	1	7,500	2,650	700	8,500	229	196	23,500	—	5 rcmg	AO
Douglas (Northrop)	8-A	A	2	M	47 9	Wr Cy G	1	7,500	2,680	840	8,700	238	208	25,000	—	5 rcmg	IP
North American	NA-44	A	1	M	43 0	Wr Cy F-52	1	5,998	1,757	760	5,800	250	225	26,000	—	5 rcmg	AO
Spartan	Zeus	A	2	M	39 0	PW Wa	1	4,953	1,513	550	5,000	234	218	30,000	760	3 rcmg	AO
Vultee	V-11-GB2	AB	2-3	M	50 0	Wr Cy G	1	10,174	4,096	850	5,800	223	206	20,500	1,060	5 rcmg	IP
Vultee	V-12	AB	2-3	M	50 0	Wr Cy G	1	9,941	3,339	900	6,500	243	218	26,000	1,075	5 rcmg	IP
Bell	BG-1	B	2	MF	36 0	Wr Cy F-56	1	6,641	2,821	755	11,300	206	—	25,500	860	2 rcmg	AO
Bellanca	28-90B	B	2	WMF	46 2	PW Tw Wa	1	7,099	2,649	900	6,200	280	250	31,500	800	2 rcmg	IP
Boeing	299 (B-17)	B	7-9	M	103 9	Wr Cy G	4	49,280	—	3,360	—	250	220	26,000	2,500	5 rcmg	IP
Douglas	B-18	B	5	M	90 0	Wr Cy G	2	23,200	8,025	1,800	—	204	180	25,000	—	3 rcmg	IP
Lockheed	14M	B	4	M	65 6	Wr Cy G-3	2	15,500	—	1,680	8,700	260	240	28,500	—	3 rcmg	IP
Martin	166	B	3	M	70 6	Wr Cy G	2	15,600	4,700	1,800	6,000	255	217	24,000	—	3 rcmg	IP
Martin	166	B	3	M	70 6	PW Tw Wa	2	16,100	4,800	2,100	6,500	268	—	26,000	—	3 rcmg	AO
Curtiss-Wright	Helldiver 77	ScB*	2	MF	34 0	Wr Cy G	1	5,710	1,544	840	8,700	235	197	27,000	610	2 rcmg	IP
Vought	V-142	ScB*	2	MF	33 3	PW Tw Wa Jr	1	5,445	1,895	750	9,000	208	172	25,000	—	2 rcmg	OP
Vought	V-156	ScB*	2	MF	42 0	PW Tw Wa Jr	1	6,500	—	750	9,000	—	—	—	700	2 rcmg	IP
Beech	M-18S	RB	3	MF	47 8	PW Wa Jr	2	8,265	3,745	800	5,000	230	—	28,000	—	2 rcmg	AO
Consolidated	PBY (F.B.)	RB	6	M	104 0	Wr Cy G	2	27,080	12,552	1,720	10,500	206	—	30,500	—	4 rcmg	IP
Consolidated	PBY (F.B.)	RB	6	M	104 0	PW Tw Wa SCG	2	27,080	12,840	1,800	—	190	—	26,500	—	4 rcmg	IP
Hall	PH-2	RB	4	MF	72 10	Wr Cy F51	2	15,547	6,270	1,500	5,800	155	—	23,000	1,928	—	AO
Curtiss-Wright	Seagull	O*	2	MF	36 0	PW Wa	1	5,192	1,649	550	5,000	168	137	17,000	697	2 rcmg	AO
Kellett	YG-1B (Auto.)	O	2	MF	40 0	Ja L.	1	2,269	650	225	SL.	128	103	—	—	—	AO
Grumman	JF-2	U*	2	MF	39 0	Wr Cy F	1	5,760	1,660	775	5,800	185	155	23,000	600	—	Ex
Sikorsky	S-43	U	5	M	86 0	PW Hor	2	19,500	6,600	1,400	6,000	190	166	20,000	—	—	AO
North American	NA-16-3	TrB	2	MF	43 0	PW Wa H	1	5,156	1,338	550	5,000	210	190	24,000	900	2 rcmg	IP
Stearman	76C3	TrB	2	MF	32 2	Wr Wh	1	3,530	969	420	1,400	156	136	21,000	550	2 rcmg	AO
Waco	WHD	TrB	2	MWF	32 8½	Wr WH	1	3,800	—	420	1,400	180	162	—	—	—	AO
North American	NA-16-4	Tr	2	MF	42 0	Wr Wh	1	4,112	1,075	420	1,400	174	164	22,000	920	—	AO
Phillips	X-PT	Tr	2	WF	36 2	Ra	1	1,690	—	165	SL.	158	139	18,000	—	—	Ex
Ryan	STM	Tr	2	MF	29 11	Men C-4-S	1	1,600	554	150	3,000	160	135	22,000	330	—	IP
CANADA																	
CC and F.	Gregor	F	1	MF	—	—	1	4,100	—	—	—	300	—	—	—	2 lbmg	Ex
Canadian Vickers	Delta (Seaplane)	U	2-3	M	48 0	Wr Cy F-52	1	7,600	2,700	760	5,800	180	—	20,500	—	—	IP
Noorduyn	Norseman (Seapl.)	U	2-3	MF	51 6	PW Wa 53H1	1	6,450	2,530	550	5,000	154	135	21,000	550	—	IP
Fleet	Trainer	Tr	2	MF	28 0	DH Gip Maj	1	1,951	831	130	SL.	113	98	15,000	320	—	AO

ABBREVIATIONS:

† Handley Page design, built by Short and Harland.
‡ Bristol design, built by Short and Harland.

DUTIES

* = Used for deck landing
A = Ground attack
AC = Army Co-operation
B = Bombing
F = Fighting
O = Observation
R = Reconnaissance
S = Spotting
Sc = Scout
Tar = Wireless-controlled target
Tp = Transport
Tr = Training
U = Utility

CONSTRUCTION

F = Fabric
M = Metal
W = Wood

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acteristics of many of the more
d abroad. The information has
accuracy cannot be guaranteed.
ata.
eed" and "range" are purely nominal, both being dependent on power output and height. The ranges quoted are generally maximum figures with normal—as opposed to "overload"—tankage and would not be attained (in most cases at least) when cruising at the speed listed. Weights and power outputs are not guaranteed accurate to within a few lb. or h.p.

Armament figures should be regarded as typical, for the great majority of military machines to-day

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Maker (and Country)	Designation of Aircraft	Duties	No. of Crew	Construction	Span	Engine(s)	No. of Engines	Gross Weight	Disposable Load	Max. Power	Max. Power Alt.	Max. Speed	Cruising Speed	Ceiling	Normal Range	Armament	Progress
					ft. in.			lb.	lb.	h.p.	ft.	m.p.h.	m.p.h.	ft.	miles		
GERMANY																	
B.F.W.	Messerschmitt Bf. 109	F	1	M	—	DB 600	1	—	—	1,050	11,800	320+	—	—	—	2 rcmg +	IP
Heinkel	He.112	F	1	M	30 2	Ju Jumo 210G	1	4,906	1,386	675	12,450	317	295	—	—	2 rcmg 2 sg	IP
Blohm and Voss	Ha.137-B	FB	1	M	36 7	Ju Jumo 210C	1	5,300	1,320	640	8,850	211	185	23,500	370	4 rcmg	OP
Henschel	Hs.123	FB	1	MF	34 5	B.M.W. 132	1	4,884	1,672	—	—	—	—	—	—	2 rcmg	OP
Dornier	Do.17	B	3	M	59 0	DB 600	2	17,857	7,408	2,100	11,800	292	270	30,000	1,490	3 rcmg	IP
Dornier	Do.17	B	3	M	59 0	Cn Rh 14 No	2	14,080	4,576	1,900	12,150	260	—	—	1,490	3 rcmg	AO
Heinkel	He.111K	B	4	M	73 10	DB 600	2	—	—	2,100	11,800	265	255	—	—	3 rcmg	IP
Junkers	Ju.86K	B	4	M	73 9	B.M.W. 132 Dc	2	—	—	—	—	—	—	—	—	3 rcmg	AO
Junkers	Ju.87	B	2	M	—	Ju Jumo 211	1	—	—	975	13,780	—	—	—	—	—	IP
Heinkel	He.118	AB	2	M	49 2	DB 600	1	9,130	3,916	950	—	261	254	31,160	650	5 rcmg	AO
Dornier	Do.18E (F.B.)	BR	3	MF	77 9	Ju Jumo 205	2	22,000	9,735	1,200	SL	161	139	—	3,000	—	IP
Dornier	Do.24 (F.B.)	BR	5	MF	88 7	Wr Cy G.	3	29,700	—	—	—	195	165	—	—	—	IP
Blohm and Voss	BV138	RB	6	M	88 6	Ju Jumo 205c	3	26,234	8,377	1,800	SL	181	147	—	—	3 rcmg +	—
Heinkel	He.270K	BR	2	M	48 6	DB 600	1	9,427	3,553	950	—	279	267	29,500	994	3 rcmg	AO
Henschel	Hs.124	BR	3	M	59 8	B.M.W. 132D	2	15,906	6,556	1,740	9,840	270	—	—	—	4 rcmg 2 sg	AO
Blohm and Voss	Ha.140 (Seaplane)	TB	3–4	MF	68 10	B.M.W. 132Dc	2	18,700	4,840	1,740	8,200	199	180	—	715	2 rcmg	AO
Dornier	Do.22 (Seaplane)	RTB	2	MF	53 2	Hi Su Ybrs	1	8,800	3,190	860	13,100	217	186	30,176	—	2 rcmg	AO
Arado	Ar.95	TSR	2	MF	41 0	B.M.W. 132 Dc	1	7,205	2,222	870	8,200	203	—	27,250	—	2 rcmg	AO
Arado	Av.95 (Seaplane)	TSR	2	MF	41 0	B.M.W. 332 Dc	1	8,090	2,491	870	8,200	187	—	25,500	—	2 rcmg	AO
Henschel	Hs.126	AC	2	M	47 7	B.M.W. 132 Dc	1	6,798	2,332	870	8,200	220	—	—	680	2 rcmg	AO
Fieseler	Storch	O	2	MF	46 9	Ar As 10C	1	2,740	770	240	SL	130	—	19,350	—	—	AO
Bücker	Jungmann	Tr	2	WMF	24 3	Hirth HM. 504	1	1,474	638	100	SL	115	106	14,000	400	—	IP
Bücker	Jungmeister	Tr	1	WMF	21 7½	Bramo SH 14A	1	1,290	365	160	SL	134	125	20,000	310	—	IP
Focke Wulf	Stieglitz	Tr	2	WMF	29 6	Bramo SH 14A	1	1,914	757	160	SL	115	107	13,500	363	—	AO
Focke Wulf	Stösser	Tr	1	WMF	34 5	Ar As 10C	1	2,191	662	240	SL	172	155	20,300	286	1 rcmg	AO
Gotha	Go.145D	Tr	2	WMF	29 6	Ar As 10C	1	3,036	1,100	240	SL	137	117	14,000	420	1-2 rcmg	AO
Gotha	Go.149	Tr	1	WMF	25 6	Ar 401	1	2,420	550	270	9,850	248	205	26,500	620	1 rcmg	AO
CZECHOSLOVAKIA																	
Avia	35	F	1	M	—	Hi Su 12 Ycrs	1	—	—	860	13,100	300	—	—	—	2 rcmg 1 sg	IP
Praga	E.45	F	1	WF	27 10	RR Kes XVI	1	3,762	978	745	14,500	255	—	34,000	404	2 rcmg	OP
Letov	S.50	O	3	M	56 10	Avia RK 17	1	8,430	2,300	830	3,000	188	166	26,000	640	3 rcmg	AO
Letov	S.50	O	3	M	56 10	Gn Rh 14M	2	9,830	2,810	1,380	5,000	230	194	30,500	—	3 rcmg	AO
FRANCE																	
Air	Payen Pa 112	F	1	—	13 7	Sal	2	1,345	397	220	—	292	—	—	495	1 sg 2 rcmg	Pr
Arsenal	30	F	1	—	31 0	Hi Su Xcrs	1	—	—	690	13,100	310	—	—	—	2 rcmg 1 sg	Ex
Caudron	Cyclone	F	1	W	29 0	Ren 12R. 01	1	3,826	750	450	11,800	300	—	30,800	—	2 sg	IP
Morane Saulnier	406	F	1	MF	35 0	Hi Su Ygrs	1	5,005	1,105	860	13,100	298	275	—	495	2 rcmg 1 sg	IP
S.N.C.A.C.	Hanriot H.220	F	2	M	42 0	Gn Rh 14 Mo	2	—	—	1,360	13,100	335	310	—	—	—	IP
S.N.C.A.M.	Dewoitine D.520	F	1	M	33 5	Hi Su 12	1	4,850	—	910	11,800	340	310	36,000	—	2 rcmg 1 sg	Ex
S.N.C.A.M.	Dewoitine D.510	F	1	M	39 7	Hi Su	1	4,410	1,110	860	13,100	249	—	35,000	435	1 sg 2 rcmg	OP
S.N.C.A.O.	C.A.O.200	F	1	M	31 6	Hi Su 12Y	1	5,511	—	910	11,800	340	310	36,000	550	—	Ex
S.N.C.A.O.	Nieuport 161	F	1	M	36 0	Hi Su 12 Ycrs	1	5,022	1,168	860	13,100	298	—	36,900	—	1 sg 2 rcmg	Ex
S.N.C.A.O.	210 (Seaplane)	F	1	M	38 8	Hi Su 9 Vbs	1	4,620	1,403	720	13,100	192.5	—	—	2 rcmg	—	IP
S.N.C.A.S.E.	Romano R.110	F	2	WM	41 11	Ren	2	7,040	2,840	900	—	290	—	34,000	810	—	Ex
S.N.C.A.S.O.	Bloch 151	F	1	M	35 5	Gn Rh 14 No	1	5,720	1,340	870	11,300	305	285	32,000	—	2 sg	IP
S.N.C.A.N.	Potez 63	FBR	2–3	M	52 6	Hi Su 14Ab	2	8,215	2,627	1,340	11,500	285	250	32,800	620	2 sg 1 rcmg	IP
Breguet	690	BA	3	M	50 6	Hi Su 14Ab	2	9,300	3,168	1,340	11,500	295	255	—	680	2 sg 1 rcmg	IP
Amiot	340 (Development)	B	3	M	75 0	Gn Rh 14o	2	19,840	9,920	3,000	14,760	348	—	32,800	1,550	1 sg 2 rcmg	Pr
Amiot	350	B	3	M	75 0	Hi Su 12Y 28/29	2	19,400	8,820	1,900	13,100	310	270	32,800	—	1 sg 2 rcmg	IP
Amiot	351	B	3	M	75 0	Gn Rh 14N 38/39	2	19,400	8,820	2,100	13,100	310	270	32,800	—	1 sg 2 rcmg	IP
Breguet	462	B	4	M	67 3	Gn Rh 14 No	2	18,040	8,530	1,900	13,100	235	—	20,000	870	3 rcmg	OP
S.N.C.A.C.	Farman 223	B	6	M	110 0	Hi Su 14Aa	4	37,890	20,850	4,480	13,100	260	—	26,250	1,490	2 sg 1 rcmg	IP
S.N.C.A.S.E.	Leo 45	B	3	M	73 10	Hi Su 14Aa	2	23,475	14,040	2,240	13,100	310	—	27,800	745+	1 sg 2 rcmg	IP
S.N.C.A.S.O.	Bloch 134	B	4	M	72 9	Hi Su 14Aa	2	21,600	8,900	2,200	13,100	273	245	26,250	1,360	3 rcmg	Ex
S.N.C.A.S.O.	Bloch 135	B	4	M	69 6	Gn Rh 14M	4	21,900	12,850	2,840	13,100	310	—	32,500	1,240	1 sg 2 rcmg	Ex
S.N.C.A.S.O.	Bloch 162	B	5	M	92 6	Hi Su 14Aa	4	42,000	18,800	4,400	13,800	295	275	29,500	870+	2 sg 2 rcmg	Ex
S.N.C.A.S.O.	Bloch 174	B	2	M	56 0	Gn Rh 14 N	2	—	—	2,100	13,800	310	—	—	870	2 rcmg	Ex
Breguet	730 (F.B.)	RB	7–12	M	132 5	Gn Rh 14 No	4	—	23,300	4,100	7,250	200	165	—	—	1 sg 5 rcmg	Ex
S.N.C.A.N.	Potez 141 (F.B.)	RB	7–12	M	134 6	Hi Su 12Y	4	50,926	30,335	4,120	13,100	199	165	18,540	—	1 sg 5 rcmg	Ex
S.N.C.A.O.	Loire 70 (F.B.)	RB	5	MF	98 5	Hi Su 9 Vb	3	24,250	—	2,190	—	150	—	—	1,180	4 rcmg	IP
S.N.C.A.O.	Loire 130 (F.B.)	RB	3	MF	52 6	Hi Su 12X	1	7,260	2,850	690	—	140	—	—	—	—	OP
Latécoère	298 (Seaplane)	TB	2	M	50 10	Hi Su 12Y	1	9,900	4,026	860	13,100	185	165	19,650	930	1 sg 1 rcmg	IP
S.N.C.A.C.	Hanriot 510	U	2–3	MWF	49 3	Gn Rh 14M	2	8,184	2,119	1,420	13,100	—	—	—	—	—	IP
S.N.C.A.S.E.	LeOC.301(Auto.)	O	2	MF	36 10	Sal 9 Ne	1	1,995	—	175	SL	112	—	13,000	—	—	Ex
Lignel	10	Tr	1	W	33 8	Ren	1	2,645	—	220	6,560	230	217	—	—	—	Ex
Morane	430	Tr	2	MF	—	Gn Rh 7 Kfs	1	3,740	990	450	7,200	198	—	15,400	—	—	Ex
S.N.C.A.C.	Hanriot H.175	Tr	2	MWF	39 4	Sal 6 Te	1	2,580	795	—	—	127	105	17,000	495	—	AO
S.N.C.A.C.	Hanriot H.182	Tr	2	MWF	39 4	Ren Beng	1	1,936	606	148	SL	118	100	17,000	363	—	AO
S.N.C.A.C.	Farman F.470 (Seaplane)	Tr	3–4	MWF	79 0	Gn Rh 9 AKX	1	13,430	3,510	960	SL	142	—	—	745	—	IP
S.N.C.A.N.	Potez 568	Tr	3	W	52 5	Pot 9E	2	5,795	—	480	SL	180	—	18,000	—	—	AO
S.N.C.A.O.	C.A.O.300 (Seaplane)	Tr	2	MF	42 7	Sal 9 ABA	1	3,750	—	230	SL	124	105	14,760	—	—	Ex
S.N.C.A.S.E.	Romano R.82	Tr	2	MWF	32 9	Sal 9 Ab	1	2,920	840	280	SL	140	124	24,500	410	—	IP
HOLLAND																	
Fokker	G.1 (Faucheur)	FBA	2	WM	56 3	Br Per X	2	10,580	2,921	1,760	15,500	301	253	31,160	945	2 sg 3 rcmg	Ex
Fokker	G.1 (Faucheur)	FBA	2	WM	56 3	Br Mer VIII	2	10,580	3,174	1,660	14,000	295	248	31,500	870	8 rcmg	IP
Fokker	G.1 (Faucheur)	FBA	2	WM	56 3	PW Tw Wa Jr	2	9,700	2,758	1,550	9,000	268	226	30,840	920	2 sg 3 rcmg	AO
Fokker	D.21	F	1	WMF	36 0	Br Mer VIII	1	4,520	1,322	830	14,000	286	239	38,240	590	2 sg 2 rcmg	AO
Fokker	D.21	F	1	WMF	36 0	Wr Cy F.54	1	4,520	1,390	690	15,300	258	215	30,840	596	2 sg 2 rcmg	AO
Koolhoven	F.K.52	F	2	WMF	32 2	Br Mer IX	1	5,511	1,874	840	14,000	237	208	31,500	715	3 rcmg	AO
Koolhoven	F.K.55	F	1	WMF	31 6	Lor Ster	1	5,026	1,499	1,000	11,800	348	300	34,000	745	1 sg 2 rcmg	Ex
Koolhoven	F.K.58	F	1	WMF	36 0	Hi Su 14Aa	1	5,621	1,653	1,080	14,760	312	280	35,000	466	4 rcmg	IP
Koolhoven	F.K.58	F	1	WMF	36 0	Br Mer VIII	1	5,621	2,150	840	14,000	286	248	38,000	540	4 rcmg	AO
Fokker	T.5	B	3	WMF	69 0	Br Peg XXVI	2	16,104	6,062	1,850	10,006	255	215	26,573	963	1 sg 4 rcmg	IP
Fokker	T.5	B	3	WMF	69 0	Gn Rh 14 Ni	2	16,104	5,180	1,960	16,000	276	232	28,850	1,012	1 sg 4 rcmg	AO
Koolhoven	F.K.50B	B	2	WMF	67 6	Br Merc VIII	2	13,000	4,887	1,680	14,000	250	225	30,500	714	3 rcmg	Pr
Fokker	T.8W (Seaplane)	TR	2	WMF	—	Wr Wh	2	—	—	840	1,400	—	—	—	—	2 rcmg	IP
Fokker	C.11W (Seaplane)	R	2	WMF	42 7	Wr Cy F.52	1	5,622	1,830	775	5,750	174	145	22,300	454	2 rcmg	IP
Fokker	C.14W (Seaplane)	RTr	2	WMF	39 4	Wr Wh E.3	1	4,298	1,433	420	1,400	143	120	17,700	590	2 rcmg	IP
Fokker	S.9	Tr	2	WMF	31 2	AS Gen Maj	1	2,149	617	165	SL	115	97	15,750	453	—	IP
Koolhoven	F.K.46	Tr	2	WMF	26 3	DH Gip Maj	1	1,918	662	130	SL	108	93	14,500	400	—	AO
Koolhoven	F.K.51	Tr	2	WMF	29 6	As Che IX	1	3,307	1,103	350	7,300	146	133	19,500	450	2 rcmg	AO
Koolhoven	F.K.56	Tr	2	WMF	37 7	AS Che X	1	3,748	1,213	355	7,000	190	170	25,500	528	2 rcmg	AO

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ENGINE(S)

Alfa = Alfa Romeo
All = Allison
Ar = Argus
AS = Armstrong Siddeley
Beng. = Bengali
Br = Bristol
Che = Cheetah
Cy = Cyclone
Dag = Dagger
DB = Daimler Benz
DH = De Havilland
Gen = Genet
Gip = Gipsy
Gn.Rh = Gnome Rhone
Hi Su = Hispano Suiza
Hor = Hornet
Is Fras = Isotta Fraschini
Ja = Jacobs
Jr = Junior
Kes = Kestrel
Lor = Lorraine
Maj = Major
Men = Menasco
Merc = Mercury
Mer = Merlin
Nap = Napier
Naka = Nakajima
Per = Perseus
Peg = Pegasus
Ping = Piaggio
Pot = Potez
PW = Pratt & Whitney
Ra = Ranger
Rap = Rapier
Ren = Renault
RR = Rolls-Royce

ORLD

achines to-day can be provided with any of a number of combinations of weapons. It will be apparent that the very latest aircraft types are not included, but the easons for their omission will be only too clear to the majority of readers. Despite uch inevitable omissions, this table can claim to be practically unique in providing means of rapid assimilation of salient facts about the world's warplanes.

Progress	Maker (and Country)	Designation of Aircraft	Duties	No. of Crew	Construction	Span	Engine(s)	No. of Engines	Gross Weight	Disposable Load	Max. Power	Max. Power Alt.	Max. Speed	Cruising Speed	Ceiling	Normal Range	Armament	Progress
						ft. in.			lb.	lb.	h.p.	ft.	m.p.h.	m.p.h.	ft.	miles		
	BELGIUM																	
IP	Avions Fairey ...	Féroce	F	1	MF	34 6	Hi Su 12 Ycrs	1	4,120	—	860	13,100	270	—	36,500	434	1 sg 4 rcmg	AO
IP	Avions Fairey ...	Fox VIII ...	F	2	MF	—	Hi Su 12 Ydrs	1	—	—	860	13,100	230	—	—	—	4 rcmg	IP
IP	Renard	R.36 ...	F	2	MF	38 2	Hi Su 12 Ycrs	1	4,850	1,550	910	13,100	306	280	39,000	620	1 sg 2 rcmg	IP
OP	L.A.C.A.B. ...	GR-8	RB	3	WMF	59 0	Gn Rh 14 No	2	14,300	6,320	223	—	—	—	28,000	—	5 rcmg	Ex
OP	S.A.B.C.A. ...	S.47	FBA	2	WMF	43 0	Hi Su 12 Ycrs	1	7,000	2,400	860	13,100	—	—	32,000	700	—	AO
IP	Renard	R.31	R	2	MF	47 3	RR Kes IIs	1	4,680	1,760	525	11,800	183	150	28,700	—	3 rcmg	OP
AO	S.A.B.C.A. ...	S.40	Tr	2	WMF	41 6	Ren Beng 4P	1	2,270	573	140	SL	144	124	22,900	435	—	AO
IP	Stampe-et-Vertongen	S.V. 4/B ...	Tr	2	WF	27 8	DH Gip Maj	1	1,720	640	130	SL	128	109	18,000	—	—	IP
AO	Stampe-et-Vertongen	S.V.5	Tr	2	MWF	34 5	AS Che X	1	3,460	—	355	7,000	172	—	23,780	—	—	AO
IP																		
AO																		
IP																		
IP	**ITALY**																	
IP	Fiat	CR42	F	1	MF	31 9	Fiat A.74RC38	1	—	—	840	12,500	279	—	31,800	—	2–4 rcmg	IP
—	Fiat	G50	F	1	M	35 2	Fiat A.74RC38	1	5,136	948	840	12,500	304	—	35,400	—	2–4 rcmg	IP
AO	Macchi	C.200	F	1	M	34 8	Fiat A.74RC38	1	—	—	840	12,500	313	—	35,400	—	2–4 rcmg	IP
AO	Meridionali... ...	Ro.41	F	1	WMF	28 11	Piag P.VII C/45	1	2,791	564	390	14,800	196	170	24,500	—	2 rcmg	AO
AO	Meridionali... ...	Ro.44 (Seaplane)	F	1	WMF	38 0	Piag P. XR	1	4,893	993	700	3,300	190	—	24,500	—	2 rcmg	AO
AO	Breda	88	BF	2–3	M	—	Piag XI RC40	?	—	—	2,040	13,100	300+	—	—	—	—	—
AO	Breda	65	AF	2	M	39 8	Fiat A.80RC41	1	—	2,400	1,000	13,450	267	—	—	680	5 rcmg	IP
AO	Bergamaschi ...	A.P.1	A	1	WMF	42 8	Alfa 125RC35	-	5,125	1,606	710	14,100	217	185	24,600	—	—	—
AO	Breda	82	B	3	M	68 11	Fiat A.80RC 41	2	—	7,055	2,000	13,450	264	—	31,000	—	3–4 rcmg	IP
AO	Caproni	Ca.135	B	3	WMF	61 8	Is Fras XI RC40	2	16,225	6,325	1,800	14,750	267	—	26,250	—	3 rcmg	OP
IP	Caproni	Ca.135	B	3	WMF	61 8	Piag P. XI RC40	2	—	7,716	2,040	14,750	251	—	23,500	—	3 rcmg	IP
IP	Fiat	B.R.20	B	4–5	WMF	70 6	Fiat A.80RC41	2	22,250	7,900	2,000	13,450	259	217	30,500	1,242	5 rcmg	IP
AO	Savoia Marchetti ...	S.M.79	B	4	WMF	69 6	Piag P. XI RC40	3	24,860	8,140	3,000	13,100	295	254	—	—	3–4 rcmg	IP
AO	Savoia Marchetti ...	S.M.79b ...	B	4	WMF	69 6	Fiat A. 80RC.41	2	22,265	7,716	2,000	13,400	255	223	—	994	3–4 rcmg	IP
AO	O.M.I.	Ca.405	B	4	WMF	59 0	Is Fras XI RC40	2	24,200	11,000	1,800	14,750	261	230	24,500	1,550	—	—
AO	Piaggio	P-32 II	B	4–5	WMF	59 0	Piag P. XI RC40	2	20,350	7,710	2,040	14,750	264	—	26,240	—	3 rcmg	IP
	Cant	Z501	RB	4	WMF	73 10	Is Fras XI R2C15	1	13,090	4,620	880	4,920	171	149	—	620	4 rcmg	OP
	Cant	Z506B (Seaplane)	RB	5	W	86 11	Alfa 126RC34	3	—	—	2,340	11,450	242	—	—	—	3 rcmg	IP
IP	Cant	Z508 (F.B.) ...	RB	6	MF	98 6	Is Fras XI R2C15	3	—	13,668	2,640	4,920	195	—	—	—	3 rcmg	Ex
OP	Caproni	Ca.124 (Seaplane)	RB	3	WMF	62 0	Is Fras XI R2C15	1	—	—	880	4,920	201	—	—	—	2 rcmg	Ex
AO	Caproni	Ca.111	RB	3	WMF	64 7	Is Fra 750RC	1	12,100	4,400	970	SL	180	—	22,500	800	2–3 rcmg	OP
AO	Macchi	MC77 (F.B.) ...	RB	3–4	W	58 4	Is Fra 750RC	1	10,560	3,960	970	SL	188	—	18,040	1,912	3 rcmg	Ex
	Macchi	C.99 (F.B.) ...	RB	5–6	W	83 0	Is Fra XI RC215	2	—	—	1,760	4,920	169	140	17,200	—	5 rcmg	Ex
	Meridionali... ...	Ro37	R	2	MF	36 4	Piag P. XI RC40	1	5,790	1,850	1,020	14,750	233	189	28,500	620	2 rcmg	AO
Pr	Meridionali... ...	Ro43 (Seaplane)	RF	2	MF	38 0	Piag P. XR	1	5,285	1,365	700	3,300	187	—	22,500	495	2 rcmg	AO
Ex	Caproni	Ca134	AC	2	MF	31 2	Is Fra XI RC40	?	—	—	900	13,100	240	210	26,250	—	3 rcmg	AO
IP	Bergamaschi ...	Ghibli	U	3	WMF	53 2	Alfa A-115	2	5,940	2,090	400	SL	158	136	16,000	—	2 rcmg	AO
IP	Bergamaschi ...	Libbeccio (Ca.310)	U Tr	3	WMF	53 2	Piag P. VII C16	2	9,060	2,540	920	5,250	218	177	21,500	620	2 rcmg	IP
IP	Breda	25	Tr	2	WMF	32 9	Alfa Lynx	1	2,200	550	220	SL	127	99	21,000	310	—	AO
Ex	Breda	28	Tr	2	WMF	32 9	Piag Stel VII Z	1	2,645	529	370	—	150	124	25,500	—	—	AO
OP	Iona	65	Tr	2	WMF	—	Fiat A.54	1	—	—	140	SL	—	—	—	—	—	AO
Ex	Nardi	F.N.305	Tr	2	WMF	27 9	Alfa-115	1	2,094	617	200	SL	192	180	22,500	310	—	AO
Ex	Nardi	F.N.315	Tr	2	WMF	27 9	Hirth HM508C	1	2,255	693	260	—	239	220	—	590	—	AO
IP																		
Ex																		
IP	**POLAND**																	
IP	P.Z.L.	Wilk	BF	2	M	36 3	PZL Foka	2	6,100	3,780	840	—	289	—	—	775	1 sg 2 rcmg	IP
IP	P.Z.L.	Sum	RBF	3	M	34 5	Gn Rh 14N	1	9,810	4,390	970	15,000	277	—	—	683	6 rcmg	IP
Pr	P.Z.L.	Los	B	3	M	59 0	P.Z.L. Peg XX	2	—	—	—	—	—	—	—	—	3 rcmg	IP
IP	L.W.S.	Zubr	B	3	WMF	60 8	P.Z.L. Peg VIII	2	15,120	—	1,700	—	236	—	—	775	4–5 rcmg	Ex
IP	P.Z.L.	Mewa	AC	2	WMF	44 2	Gn Rh 14M	1	5,320	3,850	710	—	223	190	29,000	—	3 rcmg	IP
OP	P.W.S.	26	Tr	2	WMF	29 6	P.Z.L. Wh	1	2,420	704	220	SL	127	105	15,500	—	—	—
IP	P.Z.L.	Wyzel	Tr	2	WF	30 6	P.Z.L. Maj	2	3,100	1,010	260	SL	195	160	16,000	720	1 rcmg	AO
IP																		
Ex																		
Ex	**RUSSIA**																	
Ex	State	I.15	F	1	MF	—	M25 (Wr Cy)	1	—	—	750	—	225	—	36,000	—	4 rcmg	OP
Ex	State	I.16	F	1	M	—	M.25 (Wr Cy)	1	—	—	750	—	248	—	—	500	2–4 rcmg	IP
Ex	State	I.17	F	1	M	—	M.100 (Hi Su 12Y)	1	—	—	860	13,100	300	—	—	—	1 sg 2 rcmg	IP
Ex																		
IP	State	D.1.6	FA	2	—	—	M.25 (Wr Cy)	1	—	—	750	—	226	—	31,500	525	6 rcmg	IP
OP	State	S.B.	B	3	M	—	M.25 (Wr Cy)	2	—	—	1,500	—	215	—	—	500	2–3 rcmg	—
IP	State	T.B.6	B	6–7	M	—	M.34+Hi Su 12Y	5	—	—	3,320	25,000	310	—	30,000‡	—	—	Ex
IP																		
Ex																		
Ex	**YUGOSLAVIA**																	
Ex	Ikarus	IK-2	F	1	MF	37 4	Hi Su 12 Ycrs	1	4,280	1,100	860	13,100	269	—	—	—	1 sg 2 rcmg	IP
AO	Rogojarsky	IK-3	F	1	WMF	33 10	Hi Su 12Y-29	1	5,290	—	910	13,100	327	—	—	—	1 sg 4 rcmg	IP
AO	Rogojarsky	R-313 ...	RB	2	WMF	—	Wal Sag II	2	7,050	—	1,080	13,100	235	—	—	—	—	—
	Rogojarsky	Sim-XIV-H ... (Seaplane)	O	3	WF	36 2	Ar As 10C	2	6,835	2,425	480	SL	—	—	—	—	1–2 rcmg	Ex
IP																		
AO	Rogojarsky	Sim-IX ...	Tr	1	WF	30 10	Bramo Sh 14a	1	1,495	307	160	SL	124	—	—	—	—	AO
	Rogojarsky	Sim-XII-H ... (Seaplane)	Tr	2	WF	36 0	Wal Maj 6	1	2,024	627	200	SL	124	—	—	280	—	AO
Ex																		
IP	Rogojarsky	Sim-P.V.T ...	Tr	2	WF	36 9	Gn Rh K7	1	2,886	760	420	SL	149	—	22,950	—	—	—
Ex																		
	JAPAN																	
IP	Nakajima	A.N.1	F	1	MWF	35 5	Naka Kotobuki III	1	3,270	620	600	—	260	220	—	—	2 rcmg	—
AO	Tatikawa	95-1	Tr	1	WMF	32 10	95	1	3,235	1,050	350	SL	142	—	21,300	—	—	—
AO																		
AO																		
Ex	**LITHUANIA**																	
IP	Anbo	41	O	2	MF	43 3	Br Peg XI	1	4,850	1,550	800	—	200	165	—	—	2–3 rcmg	OP
AO																		
IP	**RUMANIA**																	
AO	I.A.R.	15	F	1	MF	36 2	Gn Rh 9 Krae	1	3,630	—	600	13,100	230	—	35,500	—	2 rcmg	OP
Pr	S.E.T.	XV	F	1	WF	30 10	Gn Rh 9 Krad	1	3,410	880	500	12,100	211	—	30,800	—	2 rcmg	OP
IP	S.E.T.	10	Tr	1	WF	31 0	D.H. Gip Maj	1	1,830	550	130	SL	109	95	15,500	—	—	—
IP																		
IP	**FINLAND**																	
IP	State	Tuisku/T ...	Tr	1	WMF	39 8	AS Lynx	1	2,970	800	220	SL	129	105	15,500	700	2 rcmg	—
AO																		
AO	**HUNGARY**																	
AO	Technical University	M.21	Tr	1	WMF	27 0	Bramo Sh.14A	1	1,675	465	160	SL	125	110	14,500	—	—	—

= Potez
= Pratt & Whitney
= Ranger
= Rapier
= Renault
= Rolls-Royce

Sag = Sagitta
Sal = Salmson
Stel = Stella
Ster = Sterna
Tig = Tiger
Tw = Twin

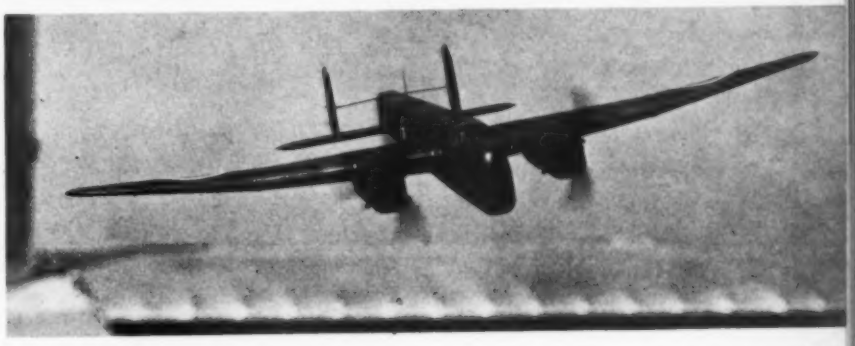
Wa = Wasp
Wal = Walter
Wh = Whirlwind
Wr = Wright

ARMAMENT
lbmg = large-bore machine gun
rcmg = rifle-calibre machine gun
sg = shell gun

PROGRESS
AO = Available to order
Ex = Experimental
IP = In production
OP = Out of production
Pr = Projected

UNIV. OF MICH.

The Heinkel He 111K with two Daimler Benz DB 600 engines is believed to equip a large proportion of Germany's bombing force.
"Flight" photograph.



The Mark IV and V Armstrong Whitworth Whitleys (second from top) are having Rolls-Royce Merlin engines. With the two-speed supercharged units the top speed should be over 250 m.p.h.
"Flight" photograph.

Vickers-Wallis geodetic construction gives the Vickers Wellington (third from top) great weight-lifting powers. The engines may be of the Bristol Pegasus, Bristol Hercules, or Rolls-Royce Merlin type.

Italy stands alone in the development of high-speed triple-engined bombers. The most recent version of her Savoia Marchetti SM79, taking advantage of the very latest Italian air-cooled engines and of Handley Page slots and flaps, is one of the fastest weight-carrying aircraft in the world to-day. A similar type, with three Alfa Romeo Pegasus engines (Bristol licence), has been widely employed in Spain, equipped with a 20-mm. shell-gun on a fixed mounting, in addition to free machine guns.

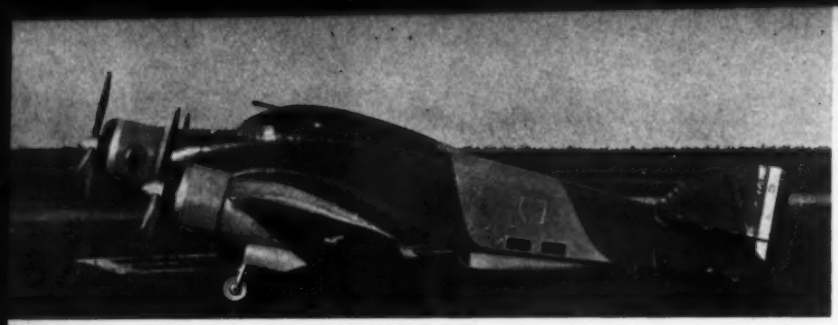
One of France's most recent prototype bombers is the four-engined Marcel Bloch 135 four-seater, using Gnôme-Rhône M14s of about 700 h.p. This machine should not be confused with the much larger though somewhat similar Bloch 162, shown at the last Paris Salon. It may be that the four little Gnômes have been fitted because units of 1,400-1,500 h.p. each, which would permit its production as a twin-engined type, are not yet available. The estimated top speed is 310 m.p.h.

The larger Bloch 162 has been designed for four Hispano-Suiza 14AA two-row radials giving 1,100 h.p. at 13,100ft. A maximum speed of 290 m.p.h. should be attained, and with fuel for a range of 870 miles (the maximum range is 1,490 miles) it is possible to carry any of the following bomb loads: 256 bombs of 22 lb.; 64 bombs of 110 lb.; 24 bombs of 220 lb.; 16 bombs of 440 lb.; or four bombs of 1,100 lb. Defensive armament includes two 7.5-mm. machine guns and two Hispano 20-mm. shell-guns, provided with 180 rounds of ammunition each.

Apart from Russia, America is the first country to standardise on four-engined bombers (excluding the War period), having adopted the Boeing B-17 monoplane with four Wright Cyclone G engines. An additional order for machines

(Below) A well-established type in service with the Italian Air Force is the Fiat BR20, a commodious machine with two Fiat radials giving 1,000 h.p. each at altitude.

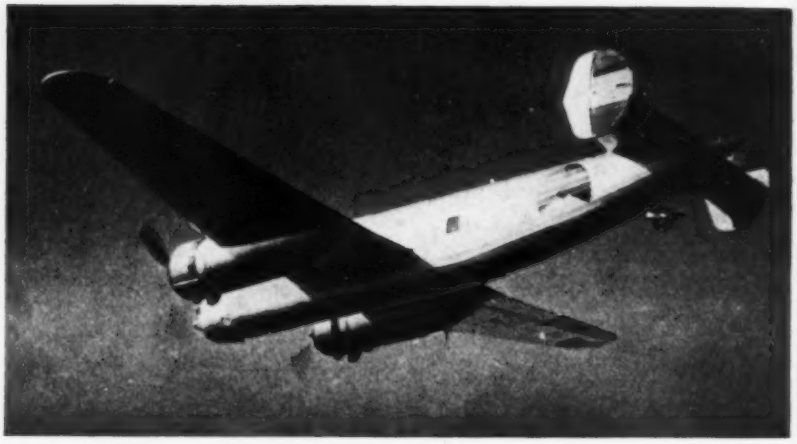
The graceful LeO 45 is in quantity production for the French Air Force. It makes use of the new Mercier low-drag cowlings. A machine of this type is to be fitted with Bristol Hercules engines.



A tripie-engined bomber which has proven itself in actual warfare is the Italian Savoia Marchetti SM79. The version illustrated has Alfa Romeo engines built under Bristol licence.

A new French prototype (middle) is this Marcel Bloch bomber with four small-diameter Gnôme Rhône M14s.

Holland has adopted the Fokker T5 bomber (below) with Bristol Pegasus XX engines. The conical gun position in the tail is a daring feature.



of this type is now being executed, though no contract has been placed for the larger XB-15, which, although fitted with four Pratt and Whitney Twin Wasps of 1,100 h.p. each, was originally planned for more powerful engines.

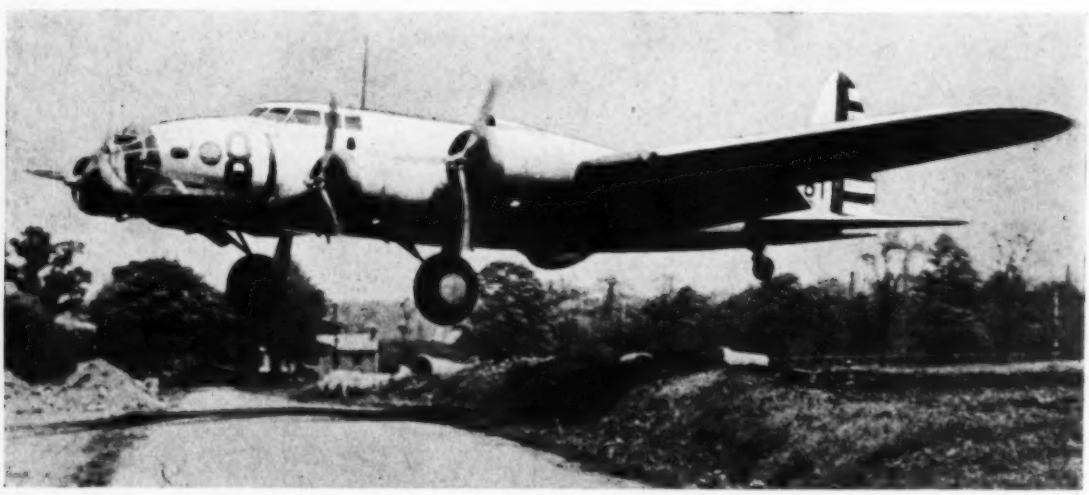
Armament of the Boeing takes the form of machine guns in streamlined "blisters" on the fuselage and in a spherical housing in the nose. There has been some talk of fitting one or more shell-guns, but no information on this subject has yet been released.

As already intimated, certain of the new Continental bombers are having shell-guns, and it is to be assumed that, now that similar weapons are in production in this country, future types of bombers for the R.A.F. will have shell-firing weapons supplementing, or displacing multiple machine guns. In view of our unique experience with power-driven turrets we should have little difficulty in installing small batteries of shell-guns.

The great majority of modern bombers carry their projectile load internally, though in some cases the bombs are stowed vertically and in others horizontally. Bomb-sighting facilities have been vastly improved during the past three or four years, and the variety of bombs available has been extended.

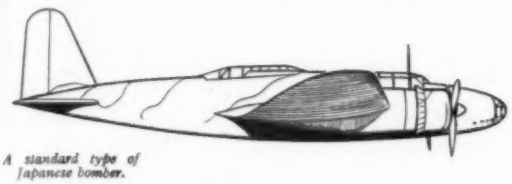
Liquid and air-cooled power plants are still fighting a ding-dong battle, though liquid cooling may shortly triumph when "buried" installations are adopted.

Structures are commonly of the normal stressed-skin type, though geodetics, "improved wood" and plastics are all likely to figure to an increasing extent.

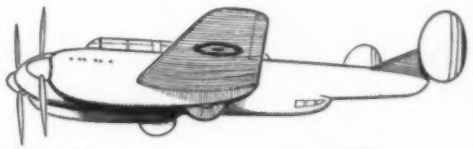


An impressive close-up of one of the U.S. Army Corps Boeing B-17 bombers (two-speed supercharged Wright Cyclones) about to touch down. This machine is considerably smaller than the XB-15 illustrated on a previous page.

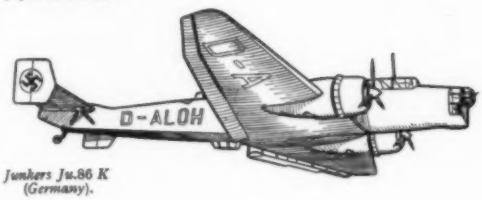
BOMBER SHAPES AND SIZES



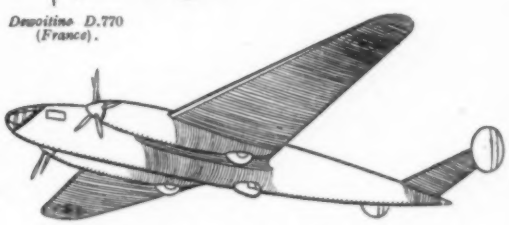
A standard type of Japanese bomber.



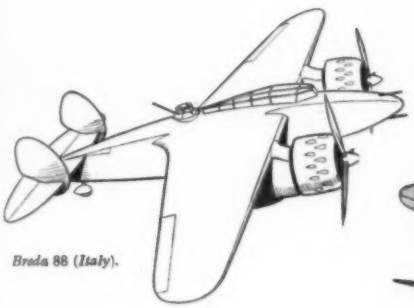
Dewoitine D.770 (France).



Junkers Ju.86 K (Germany).

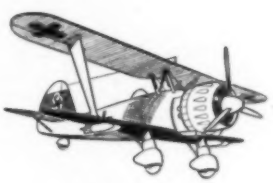


NC. 110 B5 (France).



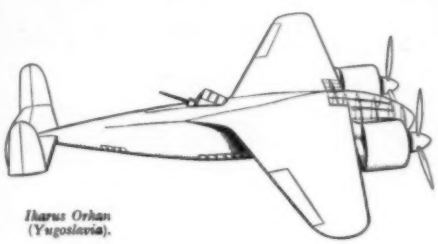
Breda 88 (Italy).

Douglas B.19 (America).

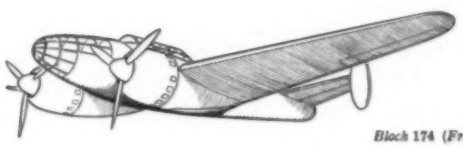


Henschel Hs 123 (Germany).

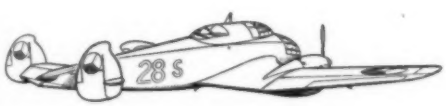
Japanese light bomber.



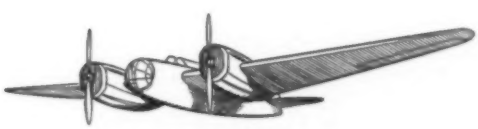
Ikarus Orkan (Yugoslavia).



Bloch 174 (France).



Avia B.158 (Czechoslovakia).



Standard Russian bomber.

That the design of bombing aircraft is as yet far from finality may be deduced from the above *Flight* sketches Nevertheless, in certain categories there are machines which bear a marked resemblance to other types, either as a result of deliberate copying or through coincidence of thought in the design office. This is exemplified by the similarity between the Breda 88, a standard fighter-bomber —said to do well over 300 m.p.h.—of the Italian Air Force, and the Yugoslav Ikarus Orkan.

The Dewoitine 770 is an interesting projected type, which may or may not be built, incorporating a lower gun position not unlike that of the Handley Page Hampden.

Another projected design, the NC 110 B5, is a five-seater bomber fitted with four Hispano-Suiza engines, each pair driving concentric airscrews. It will be seen that this is an extremely clean design, and should show a superior performance to corresponding four-engined types having radial engines in line abreast ahead of the wing.

The Douglas (Northrop) is believed to be the type ordered in quantity by France. It is also believed to have two Twin Wasps or the new 1,500 h.p. two-row Wright Cyclones and certainly has a tricycle undercarriage. The top speed is probably rather more than 300 m.p.h.

The Japanese bomber, the Russian, and the German Junkers Ju.86 are included because they are well-established standard types. The Russian has obviously been developed from the American Martin, but instead of radials it has water-cooled engines with nose radiators.

Fitted with two Gnome-Rhône 14N engines of over 1,000 h.p. each, the Bloch 174 is a fast light bomber or attack machine, built for the French Air Force. The Czech Avia B.158 is in the same category.

The little Henschel Hs.123 biplane in the centre is used in the German Air Force as a light dive bomber, though it makes quite a good single-seater fighter when shorn of its bomb-dropping gear. It is fitted with a B.M.W. 132 engine and carries four bombs of 110 lb. each in racks beneath the wings.

Topics of the Day

"Indicator" Discusses—

The Lightweight Market

and is Temporarily Pessimistic

Getting Together

ONE day in the not-too-distant future all the smaller independent manufacturers of light aeroplanes might get together in a large room and decide exactly what ought to be made for private owner, club and C.A.G. use. I am all for individuality and private venture, but just at the moment there does not appear to be a real market of any importance for a small machine made by a company with no particular backing or background.

A visitor examining some of the oddments which were to be found at any one of the more important flying meetings last year must have been surprised and shocked at the lack of cohesive thought amongst designers, and, for that matter, at the indifferent appearance, in finish and equipment, of some of the individual prototypes which were out and about for demonstration purposes.

We all know perfectly well that the conditions of aeroplane manufacture are very different from those of, say, the large-scale production of motor cars, but it is not difficult to imagine the train of thought in the mind of a complete newcomer who compares the apparent value for money offered in a single- or two-seater aeroplane costing anything up to £500 with that provided in his car, which may cost as little as £120. Additionally, the considerable difference in the various schemes of general design must have given this visitor a fair, if false, impression of the fluid state, to say the least of it, of the light aircraft manufacturing industry.

Probably at the end of this year there will be less than half a dozen types available for reasonably immediate purchase, with a few more well-known machines in the larger classes for those who can afford to spend as much as £2,000 or more on an aeroplane. Of the half-dozen, most are being, or will be, sold at any figure between £600 and £1,000, and all will have been through a period of anything up to two years of development and test work.

So many optimistic manufacturers, generally in a small way, decide to build a light aeroplane for some special purpose and expect to be manufacturing it in fully certificated form within six months or less. Experience has shown that very few single machines ever go into production after much less than a couple of years. Even if the prototype is in every way successful and suitable—as they sometimes are—it is still necessary for this first machine to be flown furiously about the country during a whole season before any of the clubs or private owners show signs of taking it seriously. Flying people are nothing if not conservative.

Facing the Facts

LOOKING at the score or so of light aeroplane types which are available now—or likely to be available if backers are forthcoming—one cannot help feeling that something like half of them have little place in the scheme of things. A few are single-seaters of no outstanding merit, though good enough in their own way—and a single-seater must be exceptionally good before its maker can possibly expect to sell it in more than single examples to a few enthusiastic owners. Others are, in some cases, two-seaters competing against much better-known British and foreign machines whose sponsors have already been trying, without much success, to sell them during the past year or so.

The moral seems to be that if you *must* make an aeroplane, make one that is either better than any other in its own class or one that has some really outstanding characteristics which are not otherwise obtainable. A well-known firm can produce almost anything that is reasonably good, and succeed in selling it partly because the prospective owners know that the firm will back them in spares and service, and partly because such a firm can afford to apply really strenuous efforts to the work of demonstrating and selling it.

Along the Brazilian coast.

It is all very well for individual makers and designers in a small way to wonder tearfully why they are not able to interest the flying public in their safe and excellent products, but each one of them should ask himself, quite honestly, whether he, in the position of a prospective private owner, would risk buying a singleton machine from a small firm when other and similar machines from much better-known factories are available at an equally low price.

One way or another, the light aircraft industry must be mildly reorganised. Owners, whether clubs or individuals, will inevitably have their choice reduced to one of the aforementioned half-dozen types—with a few American ultra-lightweights thrown in. The reduction may as well be made without necessary hardship—and those who stay in the field will deserve the money that will eventually be made in this light aircraft industry.

Concentrated Effort

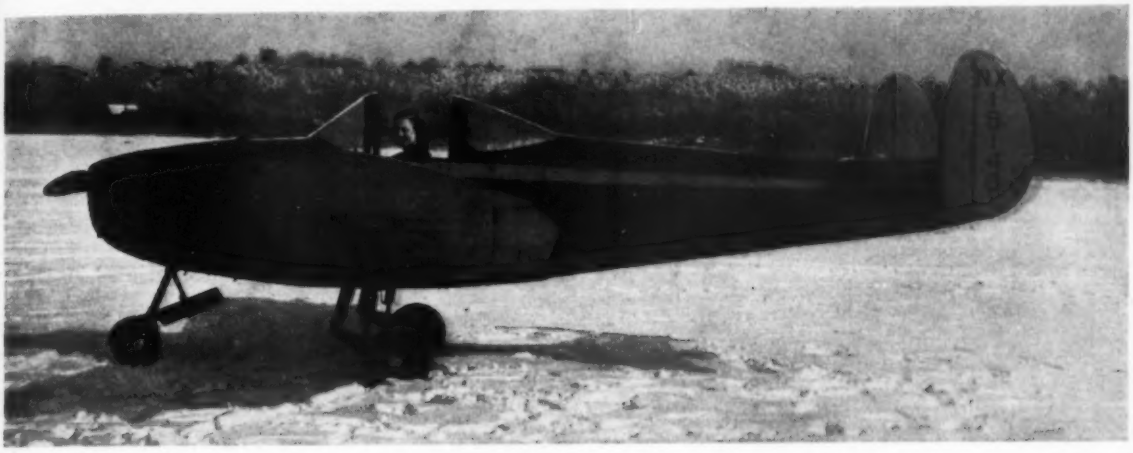
IN spite of the air of slight depression pervading my remarks so far, I still believe that there *is* a market for light aeroplanes—and a much larger one than is offered by the new club outlook alone. Properly propaganded, there are quite a few hundreds, and even thousands, of prospective owners in the country.

Any manufacturer who will concentrate on the production of an all-round type which is safe, reasonably fast, comfortable, and comparatively inexpensive both to buy and to run (insurance included), can, if he has ample patience and financial backing, interest the semi-lay public which is now, through the C.A.G. scheme, being brought into the field. Thirteen years ago D.H.'s and others managed to find a market of private owners when there

(*Continued on next page.*)

STILL MORE SIMPLICITY

The Latest Weick Design : An All-metal Low-wing Monoplane with Tricycle Undercarriage and Control Interconnection



The E. & R.C. 310 is more conventional in appearance than in fact. It has an interconnected control system and is reputed to be stall-proof. The maximum speed is 100 m.p.h. with a 55 h.p. engine.

FOLLOWING the machine which he designed to the specification of the U.S. Bureau of Air Commerce, Mr. F. E. Weick has now produced another which, though comparatively conventional in appearance, is intended as what is so inaptly known as a fool-proof aeroplane. Mr. Weick is chief designer of the Engineering and Research Corporation, of Riverdale, U.S.A., and this concern has now put the machine into production.

The E. & R.C. monoplane is a two-seater, side-by-side, low-wing machine of all-metal construction. The fuselage, which is of monocoque structure, has a sliding cabin enclosure which can be opened or shut to suit the weather conditions and the whim of the occupants. Otherwise the new Weick tends to be unconventional. It is a tractor machine with a fairly normal tricycle undercarriage, but the ailerons and rudder have been interconnected and are operated by wheel control. The machine has been designed so that it is impossible, in the ordinary course of events, to raise the nose to the stalling angle either with the engine on or off. If, however, the machine is forced into a stall, the design of the tail surfaces is such that the results are reputed to be harmless. The test machine proved to be unspinnable.

The engine, which is a four-in-line inverted air-cooled unit, has been produced specially for the machine, and is to the design of Mr. H. E. Morehouse. He has concentrated on providing absolute reliability and the unit has recently completed a 400-hour full-throttle test.

The specification of the E. & R.C. 310 is as follows: Span, 30ft.; length, 18ft. 6in.; power loading, 19.19 lb./h.p.; wing loading, 7.8 lb./sq. ft.; weight empty, 650 lb.; all-up weight, 1,100 lb.; maximum speed, 101 m.p.h.; and cruising speed, 90 m.p.h. The engine, which is also built by the E. & R. Corporation, develops 55 h.p. at 3,000 r.p.m. at optimum altitude, and weighs 2.58 lb./h.p. at maximum rating.

C.A.G.s and National Service

THE commissioners of the Civil Air Guard emphasise that in view of the National Service campaign they wish it to be known that only persons whose full-time service would be available for C.A.G. duty in time of war are now eligible to join the Air Guard.

Still Flying at Shell-Mex House

THE exhibition "See How they Fly" at Shell-Mex House, London, is to close on April 6 at 7 p.m. Originally intended to last a month, the exhibition proved so popular that it was decided to keep it open for 13 weeks, during which time it will have been visited by over 30,000 people. The exhibition is open from 10 a.m. to 7 p.m. every day except Sundays, and is free.

Soaring Classic

The Art of Soaring Flight, by Wolf Hirth; 5s. *"The Sailplane and Glider,"* 13, *Victoria Street, London, S.W.*1.

ESSENTIALLY a book for gliding enthusiasts, *The Art of Soaring Flight* may best be described as a series of dissertations on different aspects of the subject, followed in each case by descriptive articles written by various well-known and experienced sailplane pilots. Though of interest to all who take the sport seriously, it is not quite a book for the absolute novice, and the various writers take it for granted that the readers know something about the subject.

Perhaps the best of the "dissertations" is that dealing with thermal soaring, about which so many power pilots have mixed ideas. The chapter concerned is very thorough in its explanations and it is illustrated by a series of useful diagrams. As an example of the way in which the book is laid out, this chapter is followed by a description by Wolf Hirth himself about a soaring flight made in America in 1930, by a special article on thermal soaring by Ludwig Hofmann, and by two other descriptive articles on similar lines.

The British contribution to soaring flight in general is covered mainly by disconnected essays and descriptions of particular flights by some of the well-known British sailplane pilots. One of the best of these is by Philip Wills, whose article describing his successful attempt on the British height record was originally published in *The Times*; in this he gave a thoroughly satisfactory idea of the sensations experienced by a glider pilot when climbing inside a large cloud mass.

THE LIGHTWEIGHT MARKET

(Concluded from previous page)

were very few trained pilots and very few civil aerodromes. Nobody is going to tell me that light aeroplanes are less useful, comfortable and efficient than they were then—or that they cost more to run.

Unfortunately, the likes and dislikes of flying people are unpredictable, and the brave manufacturer who goes out after this market will only have a fifty-fifty chance of getting away with it. Nor will he make much money in the first year or two. But certainly it seems to be a waste of time and money to play at light aircraft production—making one or two prototypes and expecting the flying people to acclaim them as masterpieces. They may be, but the conservative public likes to see more than hand-made singleton types from a previously unknown manufacturer. Who, nowadays, would buy a car made on those lines?

INDICATOR.

Military Aircraft—III

Westland Lysanders in service with the R.A.F. (with Mercury or Perseus engine) awaiting delivery to a unit. The Lysander was designed from the beginning as a specialised Army co-operation machine.

ARMY CO-OPERATION TYPES

UNTIL quite recently, the term "army co-operation" as applied to an aircraft of the R.A.F., signified that it was a two-seater (as likely as not an adaptation of a bomber) carrying two-way wireless and with provision for a camera. The armament comprised two machine guns and, if required, a light bomb load. A hook for picking up messages was a characteristic item of equipment and the supply of message bags was at hand for reciprocal communication. The duties of such a machine were short-range, tactical reconnaissance, spotting for the artillery, photography, and supporting the army by machine-gunning or bombing troops, dumps, tanks, gun emplacements and the like.

The introduction, rather more than a year ago, of the 229-m.p.h. Lysander (now fitted with a Bristol sleeve-valve engine) signalled a new era. This outstanding Westland product had been planned from its inception as a specialised type. View for the pilot and air gunner (not "observer," for according to R.A.F. practice, the pilot of a two-seater A.C. machine does the observing, spotting and photography) were vastly improved, due not only to the high-wing layout, but to the large windows in the comfortable cockpit enclosure, the latter being another innovation.

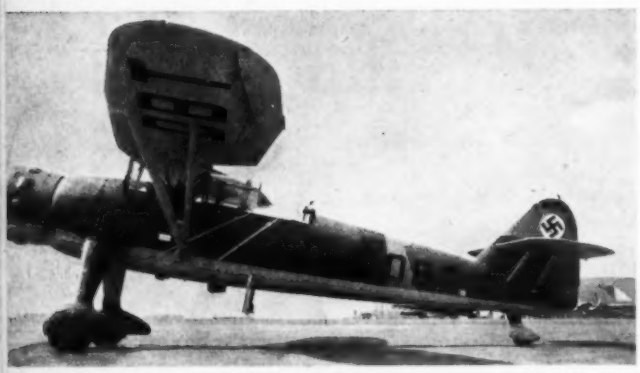
Handley Page lift slots and slotted flaps conferred additional benefits, enabling the machine to be flown, in the words of the manufacturer's test pilot, "with marked carelessness yet still with the utmost safety." Furthermore, these same devices rendered take-off and landing matters of conspicuous ease.

This unorthodox Westland has received a great welcome in the Service. Another characteristic which endears it to squadron pilots is its ability to sink slowly in a tail-down (and therefore safe) attitude when the control column is pulled right back at low speed. The machine will touch the ground safely, though the undercarriage, despite its unique sturdy cantilever design, may be severely taxed.

The Lysander formula may ultimately be developed by the adoption, say, of a Grumman-type retractable undercarriage. Doubtless, other means could be devised for carrying the machine guns, landing light and stub wings for the bomb racks.

So successful has the Lysander proved that the Polish P.Z.L. factory has built a machine modelled on almost identical lines. Even the two fixed machine guns in the wheel spats are included. A notable difference is, however, the plan form of the wing, which, in the Mewa (Gull), as the Polish effort is called, does not taper sharply toward the tips outboard of the strut attachments. The Mewa exhibited at the last Paris Salon had a wooden fixed-pitch airscrew for its small diameter Gnome-Rhône M.14, the reason seemingly being that as the machine was designed to operate from advanced aerodromes where maintenance facilities would be scanty, it was desired to reduce complications to a minimum. Nevertheless, one version has appeared with a variable-pitch airscrew.

In common with the Lysander the German Henschel Hs 126 (B.M.W. 132 Dc), the American Douglas O-46A (Pratt and Whitney Twin Wasp Junior), the French Mureaux, Belgian Renards and Lithuanian A.30s, the Mewa is a high-wing strut-braced monoplane with a fixed undercarriage. That this formula is the final formula for army co-operation aircraft is belied by the design of the North American O-47—the successor to the Douglas as the standard observation machine in the U.S. Army Air Corps. This model is of mid-wing layout there being a deep transparent



The Henschel Hs. 126 (B.M.W. 132Dc), (upper left), is a versatile German army-co-operation type bearing a distinct resemblance to the Douglas O-46-A (Pratt & Whitney Twin Wasp Junior) shown below it.

America's present standard observation (army co-operation) type is the Cyclone-engined North American 0-47. There are windows in the bottom of the fuselage.

Italy's Meridoinali Ro.37-bis is a reconnaissance type usually fitted with a Piaggio engine. There are sliding observation windows in the sides of the fuselage.

panelled " belly " under the fuselage to accommodate the observer. Due to the wing position it is fairly easy to retract the wheels.

It is not, perhaps, generally known that a machine built to the same basic layout, though lacking the portliness of the North American, has been flying for many months in this country. Details are withheld at the request of the manufacturers.

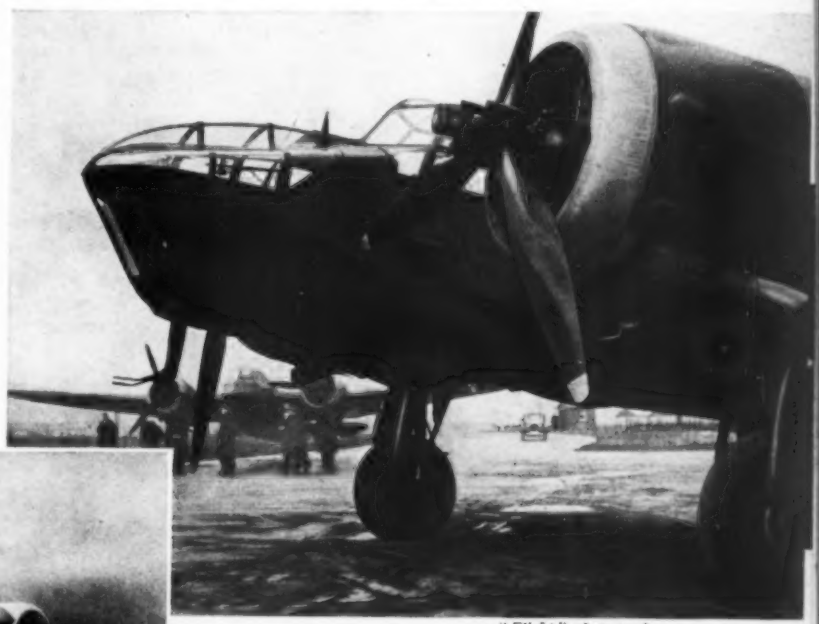
Typically, army co-operation aircraft are fitted with a medium-supercharged engine to give optimum performance at 6,000ft. above sea level. Present practice favours the radial, due to its comparative simplicity of maintenance in the field. Certainly the present standard single-engined A.C. types of the world are generally simpler than fighters and bombers, not only in their basic structure and equipment, but in their retention of the fixed undercarriage, and in some cases the fixed-pitch wooden airscrew, though the North American machine already mentioned is a perfect example of elaborate metallic modernity. A return to the biplane was essayed by Caproni with the Ca.134, which had a very powerful liquid-cooled engine, a biplane tail (!) and the typical Italian sliding windows in the side of the fuselage for the use of the observer. The Italians, in actual warfare, have achieved considerable success with the Meridionali Ro.37 biplane with either radial or liquid-cooled engine. This model is characterised by very sturdy design, and also embodies the sliding observation windows.

Comparative simplicity is to be found not only in the single-engined army co-operation types already discussed, but in the Continental *avions de travaille*—twin-engined multi-purpose types capable of acting as army co-operation machines or of functioning as advanced trainers. Crudity might almost be a better description, particularly for the Hanriot N.C.510 with its angular observation car built out from the bottom of the fuselage, its large diameter single-row radials of dated design (Gnome Rhône 9 Ksr), its fixed undercarriage and its primitive tail skid. As shown at Paris last year, the type has been extensively cleaned up and a pair of the reportedly sensitive high-revving small-diameter Gnome Rhône 14 M engines had been installed, giving a stated top speed of 218 m.p.h. Fourteen hundred horse power seems a lot even for a three-seater equipped for day and night reconnaissance, day and night flying training, instruction in navigation, bombing, and presumably for general crew training. For observation work the crew consists of the *chef de bord*, who may also act as second pilot or observer, navigator, navigator-radio operator or observer, and a machine gunner who can also work the wireless. Construction is composite, and armament comprises one fixed and one free machine gun.

One might have thought that the duties mentioned could have been discharged almost equally well by a machine of the calibre of the Airspeed Oxford or the Avro Anson. Nevertheless, the Potez 56, a machine more or less of Oxford layout, but with only 480 h.p., was adapted as an *avion de travaille*, but does not appear to have been put into production.

The Czechs seem to favour machines like the Letov S.50 and an Avia model to the same formula.

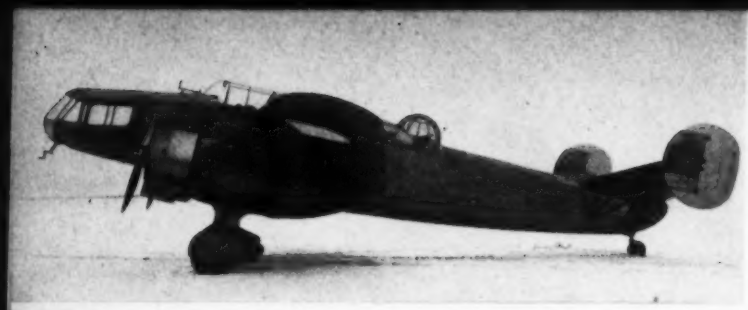
Such a machine as the Hanriot might, of course, be



"Flight" photograph.

The " long-nosed " version of the Bristol Blenheim (above) has much to recommend it as a long-distance strategical reconnaissance type.

A French *avion de travaille*—the Hanriot N.C.510—which may be used for day and night reconnaissance or advanced training. The observer's position is beneath the fuselage.



The Czech Letov S.50 (top) is a handy reconnaissance type obviously designed for a good deal of knocking about.

A Fieseler Storch demonstrates how its slots and flaps enable it to work from confined spaces.

The duties of the short-medium-range army aircraft of the future will probably include spotting, reconnaissance, photography, supply-dropping, ground attack (to a limited extent), bombing and the laying of smoke screens. Special squadrons may be allocated the work of night reconnaissance.

Henschel Hs 126 observation monoplanes of the Luftwaffe. This is one of the types released by the German Government for export.

specially recommended as a medium for using up old or surplus single-row Gnome Rhônes. Again, it might do very well in the colonies, though the machine could hardly accommodate the loads handled by specialised colonial aircraft like the Italian Capronis.

Apparently it is not intended to use the *avions de travaille* as long-distance strategical reconnaissance machines. This work calls for a multi-engined multi-seater with the highest possible performance and a range of 1,200-2,000 miles. The improved Bristol Blenheim, or some derivative type, immediately suggests itself for the job. The long-nosed Blenheim, it may be recalled, has a nominal top speed of 295 m.p.h. and a range (using 100-octane fuel for take-off) of 1,900 miles. The French have developed a special version of the Potez 63 low-wing twin-engined monoplane for R.3 (three-seater reconnaissance) duties. Performance must be seriously handicapped by the external observation nacelle. It is probably significant that a more recent version for reconnaissance duties has a transparent nose instead of the nacelle and revised cockpit arrangements.

Nations which cannot afford such a type for reconnaissance may choose a machine like the Belgian (Caproni licence) S.A.B.C.A. S.47 (somewhat akin to our Fairey P.4/34) and Germany's Heinkel He.270K.

As to the future, it may be that two main types of army co-operation aircraft will develop: first, a comfortable twin-engined two- or three-seater, slotted and flapped and reproducing, or bettering, the flying qualities of the Lysander; and secondly, the fast long-distance reconnaissance type which will probably be as speedy as anything in the air force except specialised fighters.

There are other contenders for "A.C." recognition, as exemplified by the Fieseler Storch (which can fly as slowly as 32 m.p.h.) and rotating wing aircraft. Germany is said to have attained excellent results from the Storch, which, incidentally, is notable not only for its remarkable flying qualities, but for the excellence of view as an artillery spotting and liaison machine. We, in this country have nothing similar, but, like America, are experimenting with Autogiros and similar aircraft. Such machines would be useful in Continental warfare not only for spotting and general liaison work, but as look-out posts over fortified areas. It is not to be supposed that the German Air Force has overlooked the potentialities of the Focke-Wulf helicopter.

Kellett YG-1a Autogiros of the type shown in the upper of these two views are used by the U.S. Army Air Corps. Below it is the new British C.40 Autogiro with semi-enclosed cockpit and Salmson 9 Nd engine. A small series has been acquired by the R.A.F. for army co-operation.

Spraying a thin solution of whitewash to simulate a gas attack, Douglas (Northrop) machines of the U.S. Army Air Corps demonstrate one of the functions of an attack squadron.

So low do attack machines fly that they must drop their fragmentation bombs by parachute to avoid the explosions. The machines shown below are of the standard Douglas (Northrop) type.

Military Aircraft—IV

"ATTACK" MACHINES

ALTHOUGH army co-operation machines (and for that matter, the smaller types of bombers) are used for making low flying attacks against ground targets, certain countries, notably America, have developed special aircraft for the job and have evolved suitable tactics. Targets which would make the first call on the attentions of attack machines would be troops on the march or convoys of transports, though trench strafing and the elimination of troublesome gun positions or dumps would also be undertaken. Attack aircraft might also participate in raids on industrial centres, or points of great strategical importance, flying ahead of the bombers and strafing the ground defences.

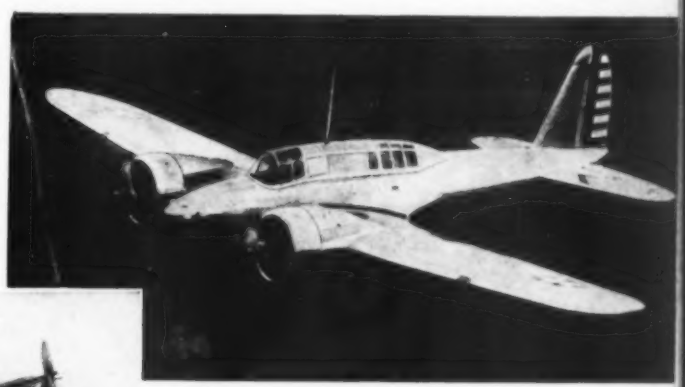
Desiderata in an attack machine are heavy armament in the form of small bombs and guns; provision for what the Americans call "chemical dispensation"; performance and manœuvrability at low altitude; minimum projected area to make things more difficult for marksmen on the ground; and engines as silent as possible.

Surprise is the essence of assault by such machines. Taking cover behind any natural features which might offer themselves they would, in theory, suddenly descend on columns of hapless troops, dispersing them with their batteries of small-bore machine guns and completing their work with fragmentation bombs or chemicals.

The bombs, which would break into as many as 2,000 pieces, might be dropped by parachutes attached to the tails of the projectiles, following American practice, enabling the machine to get clear before the explosion.

Although the single-engined Douglas (Northrop), which carries twenty 30-lb. bombs and five 0.3 Browning guns, forms the equipment of the majority of the American attack units, a number of twin-engined Curtiss A-18s are on charge for service tests. The disposable load of the Curtiss is something like 800 lb. more than that of the Northrop (which has a single Pratt and Whitney Twin Wasp Junior, whereas the Curtiss has two Wright Cyclones), the range is better and the armament load heavier.

Other well-established attack machines in use are the American Vultee and the Italian Breda. That the U.S. Army Air Corps is still interested in a single-engined attack machine is indicated by the fact that an order has been placed for a small number of improved Vultees with Twin Wasp engine. Some tacticians favour the adoption of compact, fast machines (like the Nardi FN315) for attack work. Certainly a group of small agile machines even smaller than, say, the Miles Magister, doing well over 200 m.p.h. and carrying one man, one or two machine guns,

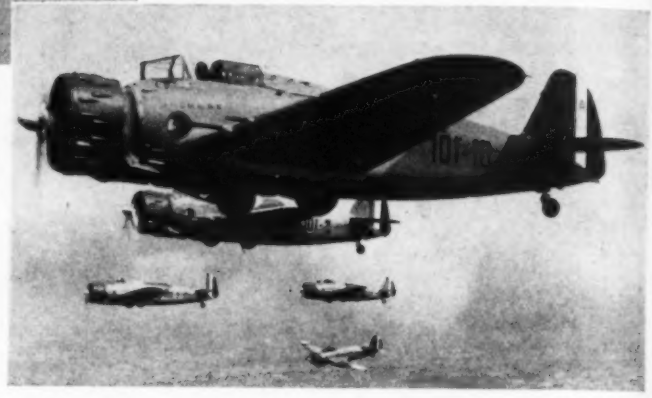


Fitted with two Wright Cyclone engines, the Curtiss A-18 (above) carries five machine guns and a substantial load of light bombs.

On the left is the Breguet 690 which has been adopted by France as a standard attack type. It is said to do more than 290 m.p.h. and to have a range of over 1,000 miles.

Fitted with nine rifle-calibre machine guns, the twin-hulled Fokker G.1 is a formidable machine for ground strafing.

(Below) A formation of Breda 65 "assault" machines of the Italian Air Force. They are normally used as single-seaters but can carry a gunner if required.

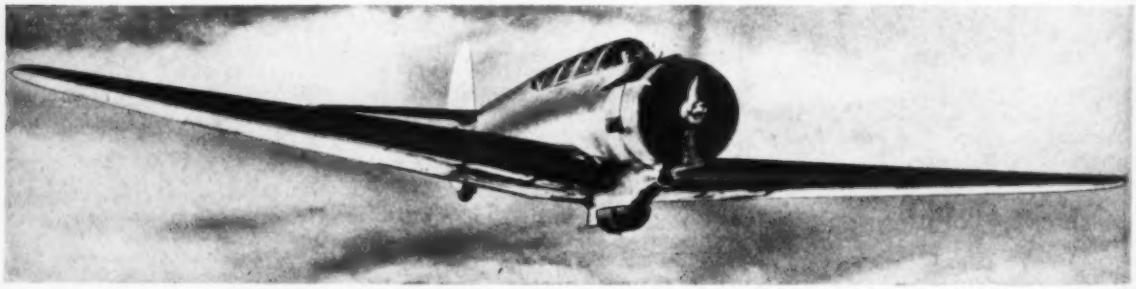


and/or a small load of bombs would be most unwelcome under many circumstances which might arise in a major war, though their short range would limit their usefulness. The French Caudron Cyclone, already discussed as a fighter, suggests possibilities. This single-seater, it may be recalled, does nearly 300 m.p.h. at altitude, carrying a disposable load of about 750 lb. The fitting of a ground-boosted engine and adaptation of armament for ground strafing would be interesting. With a quickly interchangeable fully supercharged engine the machine would serve as a useful "army" fighter provided take-off and landing characteristics were satisfactory. Having regard to the precautions being taken to defend mobile columns (light A.A. guns of about 37 mm. calibre mounted in power-driven turrets on fast armoured cars after the fashion introduced by the American Armament Corporation) large machines, which although fast are sluggish on the controls, seem undesirable.

As already stated in *Flight*, the use of first-line aircraft for army duties would be wasteful.

The French have ordered the Breguet 690 (two small-diameter Gnome-Rhône 14 Ms) for attack work. This machine is much smaller than the Curtiss, and is said to be capable of nearly 300 m.p.h. It is a three-seater and, alternatively, can be used as a bomber. All the French twin-engined fighter bombers are potentially very reasonably good attack machines, while the Fokker G-1 (*Faucheur*) has been fitted with nine machine guns (eight fixed in the nose and one in the rear conical turret) for the same purpose, though its use is also visualised as a high-altitude fighter and dive bomber.

Armour protection is coming into vogue for ground strafing aircraft, and the remarks made on this subject in the "fighter" section of this review hold good for the attack machine.



A popular attack type on the export market, the Vultee V-12 can alternatively carry a heavy load of "demolition" bombs. It is here seen with a 1,100-lb. projectile in a faired rack.

DINING THE LEICESTER R.A.F.V.R.

AT the second annual dinner of the Leicester R.A.F. Volunteer Reserve, Air Comdre. E. L. Gerrard, C.M.G., D.S.O., the commanding officer of the centre, explained how the unit had grown in strength from a number of 39 pilots last year to 109 pilots and observers this year. Actually, about eighty members and guests attended the dinner. Air Comdre. Gerrard was proposing the toast to the guests when he mentioned these figures and he said that the town centre itself had been outgrown and that, though extensions had been approved, he was afraid that by the time these were completed the number of pupils would again have outgrown the capacity of the buildings.

In his reply, the Lord Mayor of Leicester, Ald. T. J. Gooding, struck a somewhat depressing note, though necessarily so in view of the events in central Europe. He had himself spent some twenty-five years in Germany and was quite convinced that the leaders in that country were intent on world domination. He added that he would not be surprised if compulsory national service were instituted in this country in the near future.

Other speakers replying for the guests were Sqn. Ldr. G. H. Reid and Mr. H. A. Taylor, of *Flight*. The former said that the aerodrome at Desford would very shortly be increased in size to offer a two-mile landing ground and he had recently bought 1¼ sq. miles of land in the area. In opening his remarks he gave special credit to the recent Air Minister, Lord Swinton, who, he said, was largely responsible for the institution of the present reserve scheme.

D.O. Training at A.S.T.

RECENTLY Air Service Training have been including drawing-office training in their ground engineering course—the object being to give experience of drawing office practise, to give tuition in the production of plans and drawings, and, in fact, to provide a full working knowledge of all that the drawing office means in aeronautical engineering.

COMMERCIAL AVIATION

THE WEEK AT CROYDON

"A. Viator" on the Gorell Committee Report, Elephants, Shoes and Furs, Green Fireworks and Balloons

THE Report of the Committee on the Control of Flying delighted me and has achieved a niche amongst my books by leading humorists.

The Committee seems to me to be naively surprised that airscrews make most of the noise and is tolerantly severe with the boys who will be boys to the extent of flying low over large towns.

The Committee recommends that the police should be given some idea of how to estimate height, which reminds me of the Blackpudlian constable who cheerfully swore to the height of an aeroplane, but, on being questioned, admitted he had not the vaguest notion of the height of the Blackpool Tower.

No committees, possibly on account of public school education, know anything of their own knowledge, it seems to me. This particular one, being worried about the Zoo, says "Elephants, *we are told* [my italics], are very temperamental animals," and it does not even venture any idea of its own to the effect that giant sloths definitely are not. But the best bit in the report is the following: "Elephants . . . . have been badly frightened by . . . . an aeroplane flying low overhead and have, with difficulty, been prevented from stampeding, the keepers in charge having incurred minor injuries *in so doing*" [my italics again].

Elephants never forget themselves, but it looks as though keepers do, stampeding so blindly as to incur minor injuries dashing themselves against the bony sterns of yaks and elks. Doubtless, the elephants did their best to restrain the panic of their jittery attendants.

The Local Menace

"It has been represented to us," says the Gorell Committee on p. 8 of the Report, "that the primary responsibility of the Air Ministry, as conferred by the existing legislation, is the safeguarding of persons or property on the ground and of passengers in aircraft."

If it has been correctly represented to the Gorell Committee that this is the case, how is the ordinary person to comprehend the attitude of the Air Ministry towards that death-trap which it is proposed to erect quite near the Airport? I mean the 300ft. chimney which the Croydon Council wish to build in Factory Lane.

This chimney will be a very definite source of danger to persons and property on the ground in its vicinity as well as to passengers in aircraft. There is no shadow of doubt that the obstruction will be a terrible menace to air transport and that persistence in the scheme may lead to an accident so awful as to shock public opinion.

The primary responsibility of the Air Ministry in this matter is surely not to remark feebly, "we have no powers to prevent it," but to represent very forcibly indeed to the Council that the danger exists and that after the Air Ministry's grave warning the Council will take a fearful responsibility if they persist with the work.

Explorer, whose discoveries of uncharted regions seem to have taken him as far afield as Paris, where he has been resting for some considerable time, arrived here from that city on Thursday and joined the rest of the Ensign family at Hamble. Whether these aeroplanes will eventually emerge from their seclusion at Hamble and, if so, in what form, remains a mystery.

The first of the Sabena D.C.3 machines to be seen at Croydon arrived from Brussels on Thursday and another notable arrival was the red and silver Lockheed of Mr. Bata, the shoe king, who, although he did not fly here direct from Czechoslovakia, was described as having arrived like "A bata outa hell," by someone whose English still needs a slight final polish.

Mr. Bata, who, like a real monarch, keeps his private aeroplane with smartly uniformed captain and crew, was accompanied by his wife and members of his staff. It was amusing that after the original official message that the machine would land at Croydon, a further official radio was received that it was to land at Heston. It did not give the Press lads much time, but the more enterprising set off full speed by road for Heston. Soon afterwards, Mr. Bata arrived—at Croydon.

Very big consignments of silver fox furs have been coming in by air from Moscow lately. One specially chartered machine of Swedish Air Lines arrived here with a full load, and even people with colds in their heads could detect a weird aroma as the machine was unloaded. The machine was a Junkers Ju. 52, and the pilot started right back after landing, thus making the Malmö-London return journey practically in one flight.

There is, of course, a highly efficient service between Stockholm and Moscow via Riga and it is operated conjointly by Swedish Air Lines and The Board of International Airlines of the Soviet Union, a subsidiary of U.S.S.R. State Air Lines. Curiously enough, Swedish Air Lines, who operate Douglas D.C.3s on their London, Paris and Berlin lines, use Ju. 52s on the Russian run, whereas the Russian company uses D.C.3s between Moscow and Stockholm. It is still a two-day flight from London to Moscow, but perhaps we may soon need a same-day "Diplomats' Air Express" on that line.

Afternoon Pyrotechnics

A certain Air Ministry Department has just issued a lukewarm invitation (there is no reference to light refreshments) to air transport companies at Croydon to go to Lympne (of all places) at 3 p.m. (of all hours) to see a couple of green stars popped off. One star is to be fired from a mortar, and I expect the other goes off if smitten briskly with a pestle.

The department in question has a keen sense of humour, and I suspect a leg-pull, for air transport companies are not a bit interested in coloured lights designed to order aeroplanes to land. There is such a thing as wireless these days, and if you want a transport aeroplane to land you do not light a green fuzee. As for the Air Navigation (Consolidated) Order laying down rules about green fireworks, my reply is that the Ministry of Transport may have a rule in its files about men with red flags walking in front of racing cars at Brooklands for all I know, or care. The invitation ends with the remark that it is considered desirable (I would dearly love to know by whom) to obtain the opinion of the operating companies.

I've heard their opinion, but my nib is crossed and I would not curdle honest ink in trying to put such language on virgin paper.

Notable weather wizards from the Air Ministry, together with members of Imperial Airways Atlantic Division, including Capt. Wilcockson, recently went to France to inspect the Air France steamer *Carimaré*, which is to act as a special floating meteorological office in mid-Atlantic.

There are rumours that there is a special funnel on the steamer through which balloons are released for judging cloud heights. This has caused considerable interest amongst the lads at Croydon, whose balloons, unleashed from the roof of the main building, have a habit of tethering themselves to the wireless mast.

Route-testing the D.C.4

LATE this month United Airlines were due to take delivery of the Douglas D.C.4 for a fortnight of flight-testing on their coast-to-coast route. The machine is to be flown by Mr. Ben O. Howard, the company's flight research pilot, who has already put in something like fifty hours in the D.C.4 during the past few months.

Commercial Aviation

Newfoundland is Ready

THE transatlantic landplane base at Hattie's Camp, Newfoundland, has been opened for traffic, and two pilots and two engineers from Imperial Airways are now permanently established there with the meteorological staff. This new airport was described in *Flight* of January 20, 1938, and it may be remembered that the main runway is a mile long and that the other two paved runways are three-quarters of a mile long.

Actually, Imperial Airways officials have been at work in Newfoundland since 1934 making upper air surveys and taking meteorological observations. They worked previously from bases at Norris Arm, near Botwood, and Lake Quidi Vidi, near St. John's, but they and their equipment have now been moved permanently to the new airport. Needless to say, the Harrow tankers which will be used for refuelling the modified "C" class boats on the Atlantic services will operate from Hattie's Camp; two of these machines are being sent across.

No Night Mail

APPARENTLY Night Air Transport is not, if rumours are to be believed, likely to obtain a licence for the carriage of mails, freight and passengers between the new aerodrome at Grangemouth, near Stirling, and London. No official announcement has yet been made, but this interesting plan will now have to be dropped if the Air Transport Licensing Authority does not consider that the company has the necessary experience to operate an entirely new service at night over such comparatively difficult country with few radio and other ground facilities.

In the ordinary way the company deserving such a licence would be North Eastern Airways, who have had more experience than any other in operating up the East Coast to Edinburgh and beyond. And they would probably refuse to take on such a considerable job until more and better ground facilities were provided. Night Air Transport's idea was to purchase a Fokker F.22 from K.L.M.; the latter do not consider that this machine is economical enough for even the well-subsidised European runs, and it can hardly be considered a suitable machine for this particular work.

Incidentally, North Eastern Airways will, during the summer, be operating only their through service to Scotland and the machines on this run will no longer land at Doncaster and Yeadon. The service will be from Croydon, *via* Newcastle, Edinburgh-Glasgow-Stirling (Grangemouth), and Perth, to Aberdeen, the Rapides and Envoys leaving Croydon at 3.15 p.m., and Dyce at 8.15 a.m. Although the company feels, not unnaturally, that the only useful internal services are those either over sea or at very high speed and with reasonable frequency over comparatively long distances, they cannot obtain fast types in time for this year's services, and the high-speed London-Grangemouth plans must now wait until 1940, when such machines as the D.H.95 will be available and in production.

Mid-Atlantic Assistance

IT was announced last week that the French ship *Carimaré*, which has been fitted up as a floating meteorological station, has been sent on a voyage into mid-Atlantic to aid the North Atlantic flights to be made by Imperial Airways this year.

The *Carimaré*, which is to prepare weather charts and study meteorological conditions, is the property of Air France-Transatlantique, and two days before her latest departure three Imperial Airways pilots, Capts. A. S. Wilcockson, J. C. Kelly Rogers and G. I. Thomson, accompanied by weather experts from the Air Ministry, were taken over the ship by M. Louis Castex, of Air France-Transatlantique, and shown the apparatus for launching free hydrogen-filled balloons which are fitted with radio transmitters, as well as the receivers by which the messages are automatically and continuously recorded on board as the balloons rise.

This method of "air-sounding" by free balloons has been developed at the observatory at Trappes in France and is better than older methods, since conditions of visibility and weather do not interfere with the soundings. The balloon equipment goes on recording to as great a height as 13 miles, though the envelopes usually burst about 10 miles up. They have proved valuable for measuring the velocity and direction of winds, as well as for identifying and locating the different layers of density in the atmosphere.

This is by no means the first trip of the *Carimaré* into mid-Atlantic. She has made two previous trips, one in 1937 and the other last year, when the work of preparing weather charts and keeping in touch with Atlantic conditions generally proceeded as satisfactorily as on a ground meteorological station.

New A.T.L.A: Appointments

THREE new deputy members have recently been appointed to the Air Transport Licensing Authority. These are the Hon. H. O. Parker, who will act as deputy to the chairman in the latter's occasional absence, Sir James Ross, K.B.E., C.B., and Mr. E. S. Shrapnell-Smith, C.B.E. These three new deputy members will take over from time to time so as to avoid any interruption of work when any one of the three regular members of the Authority, which is under the chairmanship of Mr. Trustram Eve, K.C., is not available.

Two New Airports

BIRMINGHAM'S new airport at Elmdon will be officially opened on Saturday, July 8, by H.R.H. the Duchess of Kent. A flying display is being organised for the event and it is hoped that most of the latest civil and military machines will be represented. It is possible that among the visitors will be three Tiger Moths from the Royal Aero Club of New South Wales, which will be flown in formation from Sydney to Birmingham—though the likelihood of this trip appears to depend on the question of whether the inevitable expenses will be forthcoming, either from private sources or otherwise.

Three weeks previously the Derby Municipal Aerodrome at Burnaston will have been opened by Sir Kingsley Wood—actually on June 17. Here, again, a flying display will be staged and there will be an Aviation Banquet at the Rolls-Royce factory on the previous evening; this will be given by the Corporation of Derby. Mr. W. Courtenay is in charge of each of these opening ceremonies and displays—to which, incidentally, the Admiralty has promised to send a squadron of Blackburn Skuas, thus providing Fleet Air Arm participation for the first time at such events.

Merger Moves

LAST week Imperial Airways appointed Mr. Campbell Orde to the post of operations manager. This appointment is by arrangement with British Airways, for whom Mr. Campbell Orde previously acted for two years in a similar capacity.

At the same time Mr. E. Rawdon Smith has been appointed to take charge of what are nowadays so elegantly known as "public relations," and he will start his new duties on April 17. Mr. Rawdon Smith is at present acting in a similar capacity with the London Passenger Transport Board, a post which he has held since 1935. Called to the Bar in 1912, Mr. Rawdon Smith, after the intervening war period, returned to civil life as secretary to George Spencer Moulton and Co. and its associated companies, with whom he remained until 1926, when he went to Australia to supervise the affairs of A.E.C. (Australia) (Pty.). In 1928 he was appointed Assistant secretary of the Underground Electrical Railways group and in 1933 he became assistant secretary to the board of the newly-formed L.P.T.B.

Mr. Campbell Orde's post with Imperial Airways may be taken as one of the first signs of the impending merger, and it is probable that the various other important personalities in British Airways will be duly taken on by Imperial Airways, which is now virtually an Air Ministry controlled and operated transport company.

More Threshold Lighting

BY way of an experiment, approach, or threshold, lighting has now been laid out in the western corner of Croydon airport. This lighting will be switched on by day in conditions of poor visibility and by night, irrespective of the direction of the wind.

The system consists of four sodium lights laid down at intervals of approximately 40 metres between the inner marker and the chalk line on the axis of the ultra-high-frequency blind-approach beam, with four mercury vapour lights also 40 metres apart along a line parallel to and 60 metres to the north of the sodium lights. In last week's issue, while describing the likely developments at Heston, it was explained that a similar lighting arrangement would be laid down there. After the necessary experience has been gained it is possible that one or other of the lines of lights will be removed. The idea of having, for a start, the two lines of lights is the obvious one of discovering which can be seen more clearly in QBI conditions.

The work on the contact lighting at Heston, incidentally, is likely to take rather longer than was originally expected. Apparently, and if rumours are to be believed, some of the lights were put in the wrong way round and had to be exhumed before reinterment in the correct manner. Until the work has been completed the special "ZZ" approach facilities, as well as the blind-approach beacons will be inoperative, and blind-approach bearings will be given from the control tower.

THE "CAVALIER" REPORT

UNUSUALLY soon after the event the report of the Air Ministry's chief inspector of accidents, Wing Cdr. Vernon S. Brown, on the loss of the Imperial Airways boat *Cavalier* on January 21, was issued last week. No very new facts emerged during the enquiry, but both the crew and the operating company were freed from any attribution of blame, and the accident seems to have been the result of an unfortunate sequence of events which are not likely to occur again.

It may be remembered that *Cavalier* sank after a forced descent some 285 miles south-east of Port Washington, Long Island, and that two of the eight passengers and one of the crew of five lost their lives. The fact of the descent was entirely due to complete loss of power in the case of the two inner engines and partial loss of power in the outboard engines owing to carburetter icing trouble. The sea conditions were such that a safe landing was impossible and, as a result of damage to the hull, the machine sank in about fifteen minutes after breaking in half. All the British regulations were complied with. Evidence was taken from the surviving members of the crew and from all the ground and operating personnel concerned, while as many as possible of the surviving passengers were also questioned.

It was found that the local weather conditions and the forecasts fully justified the decision of the pilot, Capt. M. R. Alderson, to carry out the flight according to schedule and *Cavalier* took off at 10.38 a.m. About two hours later the captain decided to climb through a high cumulus cloud. Immediately after entering this cloud the radio operator experienced severe static.

He duly earthed the aerial, finally wound it in, and, because of the exceptional severity of the static, he was eventually compelled also to earth the fixed aerial. Before doing so he sent a message to Port Washington saying "running into bad weather. May have to earth." In his comments, the chief inspector explains that this message was reported in the Press as, "May have to land," and Capt. Alderson was unfairly criticised for complacency in continuing on his course for forty-nine minutes after the trouble had first been experienced.

Actually, the machine had been in the cloud for ten minutes before the engine power began to drop. He turned back towards Port Washington, hoping to regain a clear patch and thus cruise in more favourable conditions, but found that too much height had been lost to regain this patch and turned back on to his original course. If he had not done so the chances of rescue would have been reduced and, in any case, the water temperature fell by approximately ten degrees for every hundred miles nearer New York, and the possibility that any of the passengers or crew might survive the exposure would be progressively less.

The report goes on to describe the period after the crash and before the rescue, by the tanker *Esso Baytown*, some ten hours later. There were twenty-two seat-type and six crew-type preservers on board and, owing to the "unprecedented train of circumstances," it was only possible to make use of eight of them, four of each type. There was, nevertheless, sufficient flotation gear for everyone.

Among the recommendations of the investigating Board were: That the system of throttle and mixture control used must have aggravated the trouble caused by icing and should be studied in the light of this criticism. That flying-boats of this class should be modified so as to give the crew more adequate control of the air temperature, and that for emergency conditions an additional supply of heat should be provided to raise the temperature of the incoming air before it reaches the carburetter jets; as a necessary adjunct, a carburetter or temperature indicator is essential. Lastly, that passengers should be strapped in their seats at the take-off and landing. One of the passengers who lost his life was severely injured during the landing when he stood up.

Previous to the arrival of Wing Cdr. Brown in New York, Group Capt. G. C. Pirie, the Air Attaché to the British Embassy in Washington, had assembled a Board of Enquiry consisting of Sqn. Ldr. J. R. Addams (Air Ministry representative with the Lockheed and North American companies) and Sqn. Ldr. A. Ferrier (of the Royal Canadian Air Force and chief aeronautical engineer of the Civil Aviation Division of the Canadian Department of Commerce). With the Board were two observers from the U.S. Civil Aeronautics Authority. After his arrival the chief inspector reviewed the circumstances in consultation with the Board and interviewed the captain and other members of the crew.

In a statement on the report by Imperial Airways, the company, generally speaking, agrees with the findings and recommendations. They point out that the weather conditions were particularly bad and that they were, in fact, worse than any experienced during the previous eighteen months of operation on this route. The precautions against carburetter icing, consisting of three separate heating devices, were incapable of overcoming the exceptionally severe conditions. The company are undertaking research into the problems involved, and the results now obtained indicate that a solution will soon be found to meet such abnormal conditions.

Test D/F

THE difficulties experienced in test-flying really fast military machines, particularly in variable weather conditions, are shown by the fact that a special D/F station is to be installed at Southampton Airport to help Ft. Lt. Pickering and F/O. Quill in their work with the Supermarine Spitfires.

Single-seater fighters are normally fitted with two-way short-wave equipment, and the new D/F station is specially designed with a waveband and aerial system for use in conjunction with this. Fighters' radio equipment is not usually installed until after delivery to the squadrons, but in this case the sets will be installed during assembly, so that not only will the test pilots have the benefits to be obtained from its use, but also the Service pilots who are taking delivery of the machines.

The First Crossing

THE Pan-American Boeing 314, *Yankee Clipper*, left Baltimore at 2.34 p.m. on March 26 on the first stage of the machine's initial Atlantic crossing. A few minutes less than five hours later the crew reported that the boat had covered 733 miles (showing an average of 146 m.p.h.), and Horta, in the Azores (2,448 miles from Baltimore) was reached at about midday on March 27, after a flight of 17 hr. 37 min. (140 m.p.h.). The machine was due to leave for Lisbon, Marseilles, Southampton, and Foynes on March 28.

In all there were twenty-one people on board, and the take-off was apparently made in about thirty seconds without any difficulty from calm water. The flight is to be completed at the commander's discretion, according to circumstances and weather conditions. In charge of the machine is Capt. Harold Gray, who will be remembered as the chief pilot of the S.42B. used for Pan-American Airways' Atlantic experimental flights in 1937, and he has eleven operating members of the crew with him. As Government observers there are three officers of the armed forces and three officials of the Civil Aeronautics Authority. The other passengers are Mr. J. H. Schildhauer, the operations manager of the Atlantic division of P.A.A.; Mr. E. Duff, of the Boeing Company; and Mr. A. B. Gaylord, representing the Curtiss-Wright Corporation, the manufacturers of the two-row 1,500 h.p. Cyclones, four of which are fitted.

Rapid Refuelling

MODERN air transport and Service needs demand not only mobility but large capacity and quick delivery in refuelling equipment, and the latest thousand-gallon airport service tanker used by Intava is an interesting example of such equipment. This tanker can, if necessary, deliver fuel at the rate of 70 gallons a minute, though, normally, each of the three pumps discharges at a maximum rate of 30 gallons a minute.

One of the more unusual features of this vehicle is that the pump drive is made directly from the rear of the power bogie, which is directly below the pump chamber; the necessity for obtaining a drive from the normal gear box at the forward end of the chassis is, therefore, avoided. The three pumps are driven by silent chains and controlled by a positive clutch operated from the cab. Each of the pumps is of the radial-piston type, with the four pistons operated by a central eccentric while the cylinders are rotated. Thirty feet of hose is available for each pump, and this length is wound in each case on to an automatically operated drum which draws the hose back after use. Consequently, no trouble is caused through lengths of hose lying untidily about the place. As much hose as is required, and no more, is hauled out by the operator.

On the port side of the tanker are hand-pumps and meters for lubricating oil, of which two grades are normally carried, while a power-driven air compressor is provided for dealing with aircraft tyres.

FROM the CLUBS and SCHOOLS

NORTH BRITISH.
CIVIL Air Guard members logged 23 hr. 15 min. last week. Owing to high winds and poor visibility no flying was possible during one day in the week.

WESTON.
For the week ended March 21, 47 hr. were recorded. Mr. P. Stabbins has passed his "A" licence tests.

YORKSHIRE.
Close on 71 hr. were recorded last week. In the C.A.G. section Messrs. R. Chapman and R. Wark went solo and H. Gledhill obtained his "A" licence.

BURY ST. EDMUNDS.
Strong winds brought the club's flying time down to under 20 hr. last week. Six new members have joined the club and three have joined the C.A.G. The clubhouse will be officially opened on April 1.

STRATHTAY.
For the first three weeks of March, 109 hr. were recorded, of which the C.A.G. accounted for 49 hr. Mr. Munro has gone solo, and Mr. D. Rose has carried out his "A" licence tests.

PORTSMOUTH.
Members of the C.A.G. were able to record 73 hr. during the first 25 days of March. In the same period club members flew 99 hr. High winds restricted flying last week.

YAPTON.
During the first 25 days of March, C.A.G. members have flown 75 hr., while Club members have recorded 21 hr. Bad weather conditions considerably restricted flying last week.

LONDON.
During last week the flying time amounted to 60 hr. 45 min. Captain P. Triefus completed his "A" licence tests, while Messrs. R. A. Bradner and S. C. Bentley made their first solo flights.

WITNEY.
The flying time for the first 24 days of March amounted to 104 hr. Mr. J. Kirtland has made his first solo flight. The club has purchased another B.A. Swallow.

REDHILL.
Although high winds considerably affected flying times for last week the club was able to record 74 hr. Messrs. J. Monk and F. C. Hill have passed their "A" licence tests.

IPSWICH.
Bad weather reduced flying time to 19 hr. for the week ended March 21. Two ground lectures per week are given for C.A.G. members.

PLYMOUTH.
In spite of two days being unsuitable for instruction 70 hr. were flown by the club during the week ended March 21. Messrs. E. V. Dunn and W. E. Wroughton have made their first solo flights.

BENGAL.
Over 81 hr. were flown during the month of February. In the annual flying gymkhana Messrs. K. R. Das, D. A. Bruce, H. H. Marshall and L. Mills were winners of the various competitions held. Mr. K. C. Sarker went solo.

DONCASTER.
Although high winds prevented instruction on one day, 53 hr. 58 min. were flown last week. Mr. J. Sprague went solo, while Miss Bowe, Messrs. R. Harper and A. Wigglesworth have carried out their "A" licence tests.

BRISTOL.
Mr. D. Kerr Robertson has been appointed an instructor to the club. Work on the new clubhouse extension has been started. Last week club machines flew 27 hr. 25 min. Mr. T. R. Jenkins has gone solo.

LANCASHIRE.
Owing to rough and squally winds only 25 hr. were flown last week. Eight new members joined the club. Mr. A. Millward, of the C.A.G., has passed his "A" licence tests. The monthly C.A.G. supper will be held in the club lounge on April 1 at 7.30 p.m.

EXETER.
During the week ended March 21, ¾ hr. were flown. Mr. J. F. Davies made his first solo flight. On Saturday the club lost to the Seaton Golf Club at squash racquets, but won the following day against the Cranford Ladies' Club of Exmouth.

THANET.
During the week ended March 21 high winds restricted flying to 1½ days, but in spite of this setback 27½ hr. were flown. Messrs. K. L. Collinson and J. H. Ballard have passed their "A" licence tests.

HORTON KIRBY.
Rough weather somewhat reduced the club's flying time for last week, but over 20 hr. were logged. Over 70 C.A.G. members have been enrolled while six new members have joined the club. Vacancies still exist for new C.A.G. members living in or near South London.

SOUTH COAST.
Mrs. Hillier and Mr. R. A. Bailey, of the C.A.G., have qualified for their "A" licences. Messrs. Newton and O'Rourke have made their first solo flights. During last week 36 hr. were flown in club aircraft.

ROMFORD.
Gusty weather last week reduced the flying time at Chigwell to 15 hr. The Romford C.A.G. have elected their air leaders. The No. 6 (Romford) Sqn. of the A.D.C.C. will hold a camp at Easter in a field adjoining Maylands aerodrome.

NORWICH.
Two C.A.G. members went solo last week in spite of the high winds which made instruction impossible during three days. Mr. Alex Henshaw has accepted an invitation to be the club's guest at the dance to be held on April 21.

NEWCASTLE.
The club flying time for the fortnight ended March 23 amounted to 47 hr., while C.A.G. members logged 119 hr. Messrs. C. B. Charlton, W. E. Walker, R. R. Croker and K. S. Thomson have gone solo, while Messrs. A. Coulson and J. P. Eskdale have passed their "A" licence tests.

BEDFORD.
Over 100 members and friends attended the club dance last week. The Misses Y. Newman and M. Grimmer were presented with trophies for being respectively the first girl soloist and the first girl to obtain an "A" licence at Barton. Messrs. W. H. C. Davies and A. Gregory have passed their "A" licence tests, while H. M Kendall has gone solo.

MARSHALL'S.
The total flying time for last week amounted to 98 hr. 20 min. Messrs. J. K. Moss and S. J. Pearmain went solo and Mr. K. Tomkinson has passed his "A" licence tests.

A total of 135 hr. 40 min. was flown by Marshall's Flying School during the week ended March 18. In the C.A.G. section Miss Vernon and Mr. Hiscock carried out their first solos, and Mr. Anderson completed his "A" licence tests.

PENANG.
A great improvement was shown in the flying hours during January, in spite of the fact that bad weather prevented flying on several evenings, and 128 hr. 45 min. were logged. Mr. R. T. G. Arthur made his first solo during the month, and both he and Mr. Harvey have now completed their Straits Settlements "A" licence tests. Ten Vickers Vildebeests of No. 36 Squadron, R.A.F., from Singapore passed through Penang on their way to Akyab under the command of Sqn. Ldr. Wallace. They returned later in the month, spending the night at the club.

COUNTY.
Although the County Flying Club of Leicester lost rather more than £600 during the year which ended on September 30, 1938, the club's position is not as bad as it appears. Nearly £400 of the deficit was due to the business of leaving the Leicester clubhouse and to some trouble over the sale of ground training machines. Since the C.A.G. scheme was started, 28 licences have been obtained by members and 140 are now in training. On September 30 there were only 62 flying members of the club, while at the end of February there were 147. Sir Lindsay Everard, M.P., inspected the newly uniformed members of No. 1 Squadron of the Air Defence Cadet Corps at Leicester last Sunday, and another squadron, No. 51, will shortly be established.

The A.D.D.C. Fund

THE Air League of the British Empire has now received the whole of the £25,000 for the Air Defence Cadet Corps Central Fund. This was the sum asked for by Air Marshal Sir John Salmond in the Mansion House last October. The figure has been completed by a substantial cheque from Mr. S. Marks, who is hon. treasurer of the A.D.C.C. Committee and vice-president of the Air League.

More than ninety squadrons have now been formed, with an establishment of more than 9,000 cadets. Of these squadrons 14 have been formed in the London boroughs and 40 in the Greater London area.

A Hampshire Change

THE chief instructor of the Hampshire Aeroplane Club, Mr. K. C. Winton, who has held this position for the past three years, is leaving the Club at the end of the month to join the instructional staff of Air Service Training, at Hamble. Mr. Winton joined the staff of the Hampshire Aeroplane Club seven years ago, when the Club's headquarters were at Hamble, after varied Service experience, during which he was posted to the C.F.S. in 1931 as an "A.1" instructor.

He will be succeeded by Flt. Lt. Normand B. Littlejohn, who has been with the Club since last August. Born at Sydney, Flt. Lt. Littlejohn has had extensive R.A.F. and R.A.A.F. flying experience; before returning to England last year he was instructor to the Roval Aero Club of New South Wales.

FLYING and the CITIZEN

The Findings of the New Gorell Committee : Consideration for the General Public

AT the end of October last year a committee, under the chairmanship of Lord Gorell, and including a number of well-known personalities in aviation, was appointed to "examine the existing regulations governing the flight of aircraft over populous and other districts, and the adequacy of the means of their enforcement; and to consider whether further measures were required to regulate such flying in the interests either of the safety or the amenities of the public." Four months later the Gorell Committee's report was submitted, and this has now been duly published in the form of the accustomed White Paper.

Matters as widely different as the passage of aircraft over Zoos and the technical problems involved in silencing are covered in this report, and among the recommendations of the Committee are that banner-flying shall be restricted and that licences for this work shall not be renewed after October 1, 1941; that the flight of single-engined machines over large cities and towns shall be prohibited; and that a new form of licence shall be introduced for the purpose of protecting the public from dangerous flying by pupils.

In the first case the Committee did not consider that the immediate prohibition of banner-flying was called for, but it was recommended that it should be discouraged by preventing any addition to the number of aircraft at present operated for this purpose. If the banner-flying industry reached large proportions there would be no hesitation about prohibiting this form of advertising, and it seemed fairer to make a clean cut now before more capital was sunk in such enterprises. It had been suggested that aerial photography might be a potential cause of disturbance, but it was pointed out that these operations are usually carried out at about 8,000 ft. and that very few complaints had been received on the subject of oblique photography from lower altitudes. The Committee did not recommend the imposition of any form of restriction for photographic flying.

Service Co-operation

The Committee were careful to record that the Royal Air Force authorities did everything possible to prevent or minimise causes for complaint in the matter of low flying, but they recommended that whatever measures might be applied to civil flying should also be adopted, as far as possible, by the Service.

They duly suggested that the Air Ministry should make of laying down, and revising from time to time, a standard of maximum "noise output" for all machines, especially those employed in primary training, whether Service or civil. A certain amount of low flying is inevitable when machines are landing and taking off, but the Committee recommended that the regulations in this matter should be modified to bring them into line with modern conditions and present-day practice. It was impressed that the major scheme for the improvement of Croydon should be put in hand as soon as was practicable (i.e., when Heston had been enlarged, and Fairlop and Lullingstone laid out), and that all pilots should make use of the greatest possible length of runway so that their machines would be at a reasonable height immediately after they had crossed the boundary. The value of property in the vicinity of Croydon has, in fact, depreciated from 35 to 50 per cent., and there are more than eight hundred houses for sale in the district.

In the matter of licensing (and following the American system) the Committee recommended that an additional licence, known as a "student pilot's" licence, should be instituted, and that this should be obtained (after the necessary medical examination) before any instruction was received. No private pilot should, in the opinion of the Committee, be permitted to carry passengers until he had flown for twenty solo hours—after which, when his logbook, duly certified by the instructor, had been examined by the Air Ministry, his licence would be endorsed with the words, "permitted to carry non-fare-paying passengers."

In order to prevent low flying and other offences which might cause danger to the public by pupil pilots, the Committee suggested that the soundest method of control will be to endue the flying instructor with some real statutory significance. The chief instructor at each training centre would, therefore, normally fulfil the duties of a control officer. More important, perhaps, in this connection was the recommendation that a number of control officers should be officially appointed at every aerodrome where flying instruction was given, as well as at major airports and some others open to public use. These control officers would be vested with summary powers to prevent any flying in contravention of regulations. It was considered undesirable that a control officer should be responsible for deciding whether or not the weather was fit for a transport machine to take off. This should be left to the pilot and the operating company.

The Committee considered that the only satisfactory method of safeguarding the general public from low-flying dangers was to prohibit certain types of aircraft from flying over densely populated areas. They recommended that only those multi-engined aircraft capable of maintaining height with one engine out of action should be permitted to fly over such areas—which would be prescribed by the Air Ministry. The present regulation is that "an aircraft shall not fly over any city or town . . . except at such altitude as will enable the aircraft to land outside the city or town should the means of propulsion fail . . . " Special additional prohibitions referring to exhibition work, to flying over a "large concourse of the public," and to causing unnecessary danger to any person or property have since been added.

Citizens and Denizens

The question of causing unnecessary danger to animals (and, indirectly, to individuals) was also considered. Amendments should, they thought, be made to the appropriate regulations, and machines should not be permitted to fly over, or in the immediate vicinity of, the London Zoo. They were not in favour of extending the prohibition either to Whipsnade or to other zoological gardens.

In order that the enforcements of the regulations should be more thorough and practical, it was recommended that arrangements should be made to enable police officers to become better acquainted with air matters generally. In this way more stringent use could be made of the power of suspension or cancellation of licences in the case of those pilots who had offended either against the regulations or the aerodrome rules.

In conclusion, the Committee considered that "modern developments in aeronautical technique had intensified the inconveniences resulting from the flight of aircraft over populous areas, at all events in the vicinity of aerodromes," but, on the whole, Service and civil flying gave rise to a surprisingly small number of complaints from the general public. They felt certain that aircraft noise, the principal cause of concern, was capable of useful reduction.

When offences had been committed the fines imposed were rarely commensurate with the gravity of the offence, and the cancellation or suspension of licences would constitute a more effective punishment. In a general way, there was, the Committee thought, need for a stricter control at aerodromes, where at present the officers had insufficient powers. In particular, Croydon airport presented a problem of special difficulty to the local residents, and the interests of the latter could not adequately be protected except by abandoning the site altogether.

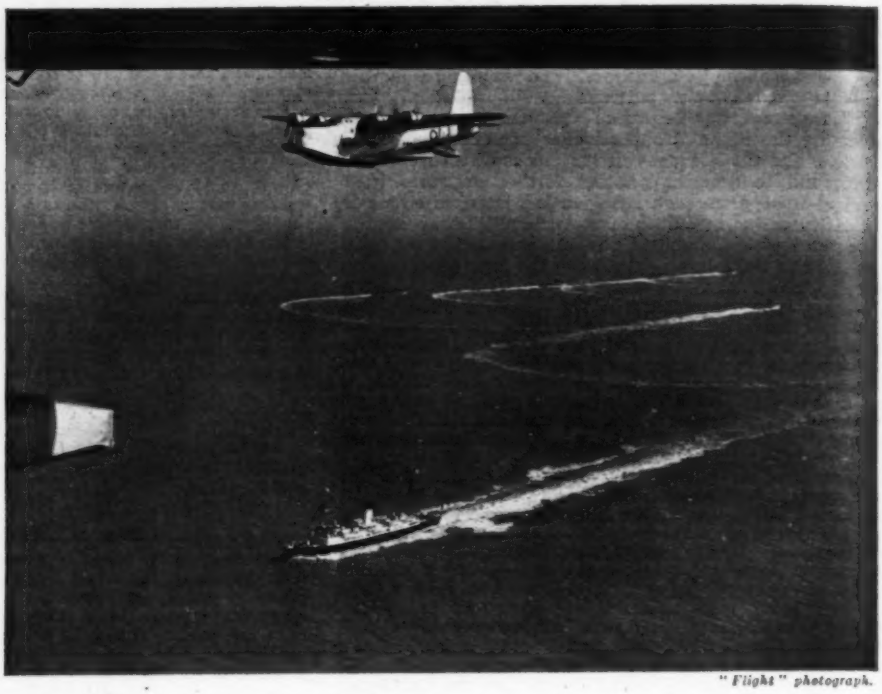
A "Silencing" Committee?

Among the detailed recommendations were: that a technical committee should be set up to investigate the possibility of reducing aircraft noise (at least in the case of training and similar machines) and of making regulations for control in this matter; that, in case of future trouble, "sky shouting" (or broadcasting from the air) should be prohibited; that the passage of machines over areas set aside for defence training exercises at night should be prohibited during the period of these exercises except in the case of the actual machines being used; that the problems associated with the development of aviation (and the impracticability, in fact, of eliminating all noise and low flying) should be made more widely known to the general public; and that the Ministry of Health should be consulted when new aerodrome sites were being considered.

The members of the Committee were Sir Lawrence Chubb, Sir Alan J. Cobham, Miss Pauline Gower, Mr. F. Montague, M.P., Sir Hugh Seely, M.P., Mr. W. P. Spens, K.C., M.P., and Major R. H. Thornton.

SERVICE AVIATION

Royal Air Force and Official Announcements : Fleet Air Arm News : Military Aviation Abroad



" *Flight* " *photograph.*

ESCORT : One of the Sunderlands which, with a formation of Ansons, escorted the steamer *Cote d'Azur* when she brought President Lebrun to England last week. The French escort of destroyers is seen turning back after handing-over to the Royal Navy in mid-Channel.

Australian Production

IN reply to a question in the House last week by Mr. Dalton (Bishop Auckland, Lab.) the Air Minister said he was glad to be able to announce that the United Kingdom Air Mission, which, by arrangement with the Government of the Commonwealth of Australia, had been investigating the possibility of aircraft production in Australia, had now completed its report. The Mission's recommendations had been considered by the United Kingdom Government and the Commonwealth Government and both Governments had decided to accept them generally and put them into operation forthwith. Immediate action would be taken for the manufacture in Australasia of airframes to a British design suitable for Australian requirements and also for those of the Royal Air Force in the Far East.

The report of the Mission emphasised the extent to which engineering resources had been developed in recent years in Australia. Full advantage would accordingly be taken of these resources by a system of widespread sub-contracting throughout the engineering industry. This would accelerate production in peace and create a capacity for expansion in emergency. Arrangements were being made for the supply from England of engines and certain materials and items of equipment, pending completion of arrangements for their manufacture in Australia.

The Wirraway Takes the Air

IT is learned that the first Wirraway—the multi-purpose type built in Melbourne under licence from the North American Aircraft concern—has made test flights.

Rugby: R.A.F. Beat Army

THE R.A.F. reconstituted XV beat the Army last Saturday at Twickenham by a goal, a dropped goal, a penalty goal and two tries to one penalty goal: 18 points to 3. The result came as a surprise to the critics, for the Army had a very strong team, plentifully supplied with internationals, and it had drawn with the Navy. As the Navy had previously beaten the R.A.F., all the odds seemed on the Army in the final match.

The R.A.F., however, surpassed themselves, and Walker played one of the best games of his career. The Army were superior in the set scrums, but in the open the R.A.F. forwards were all over them. The Army were the first to score with a penalty goal, but Irens made the scores equal with a very good penalty kick. Half-time found the teams on level terms. In the second half the R.A.F. asserted their superiority, and first Rogers touched down for a try after Walker had skilfully punted over the line. Then Walker dropped a very fine goal and the R.A.F. began to play like victors. Cobden made a splendid burst and scored far out, and just before time Walker himself burst through the centre with a most elusive run and scored under the posts. Irens kicked the goal As a result, the Navy are the champion Service, and the Army have the wooden spoon. Teams:—

ARMY.—Lt. R. N. B. Holmes, Lt. F. J. V. Ford, Lt. R. Leyland, Lt. J. Harrison, Lt. D. C. Bevis, Sergt. H. Ibbitson, Lt. J. L. Chambers, L/Cpl. E. W. Farmer, P.S.M. C. R. Owen, Lt. J. L. Melville, Capt. V. F. D. Tarrant, Lt. C. L. Melville, Lt. A. J. A. Arengo-Jones, Lt. R. L. France, Capt H. J. Sayers

R.A.F.—Sergt. E. J. Parsons, P/O. D. O. Cobden, F/O. A. V. Rogers, F/O. C. D. Garvin, L. A/C. T. B. Mahoney, F/Lt. C. A. Walker, P/O. T. Balmforth, P/O. T. F. T. Chambers, F/O. L. Fox, P/O. K. P. English, F/O. H. J. Irens, F/O. J. A. Roncoroni, Sergt. W. C. Gascoigne, F/Lt. C. H. Beamish, L. A/C. J. Holland.

Reunions

THE 22nd annual reunion dinner for officers of No. 46 Squadron, R.F.C. and R.A.F., will be held on Saturday, April 1, at Oddenino's Restaurant, Regent Street, London, W.1, at 7.15 for 7.45 p.m. Dinner jackets, without decorations, will be worn. Tickets are 25s. 6d. (inclusive of cocktails, wines, etc.), and may be obtained from Capt. C. J. Marchant, 85, Queen Victoria Street, London, E.C.4.

The date for the second "Gosport Reunion." at Brooklands, has been fixed for Saturday, July 15, and Col. R. R. Smith Barry has again kindly consented to take the chair. Those pilots and instructors who passed through the School of Special Flying, Gosport, during the period July, 1917-November, 1918, and who would like to attend this year's dinner, should get in touch with Capt. H. Duncan Davis, A.F.C., at the Brooklands Flying Club, Brooklands Aerodrome, Weybridge, Surrey.

New R.A.F.V.R. School

ARRANGEMENTS have now been completed for the entry of personnel for training at a new Volunteer Reserve training centre, to be situated at West Hartlepool Municipal Aerodrome, which is to be formally opened by Sir Kingsley Wood on April 15.

Applications are invited immediately from candidates resident in this district to enter as pilots, air observers, or wireless operator/air gunners.

Candidates must be British subjects, between the ages of 18 and 25 for the pilot section, and 18-32 for the observer and wireless operator/air gunner sections. They must be physically fit and of good education Previous flying experience is not necessary.

Until further notice they should apply for detailed particulars to the Air Officer Commanding, Reserve Command, Royal Air Force, Hendon, The Hyde, London, N.W.9. Candidates are interviewed and medically examined in their own district.

Flying Accident

THE Air Ministry regrets to announce the following accident:—P/O. Joseph Benjamin Raven (pilot) and P/O. Anthony Stewart Peter lost their lives in an accident which occurred at Fenny Compton, near Leamington, on March 20 to an aircraft of No. 23 (Fighter) Squadron, Wittering.

Royal Air Force Gazette

Air Ministry, March 24

Royal Air Force

General Duties Branch

Group Capt. J. C. Slessor, D.S.O., M.C., is appointed Air Aide-de-Camp to the King (January 1), in the vacancy created by the promotion to air rank of Air Comdre. J. C. Russell, D.S.O.; Flt. Lt. R. H. Young is granted a permanent commission in that rank (August 12, 1938) (Substituted for notification in *Gazette* of August 16, 1938); Flt. Lt. P. H. Dunn is granted a permanent commission in that rank (March 3); Flt. Cadet D. G. Marshall, having successfully passed through the Royal Air Force College, Cranwell, is granted a permanent commission as Pilot Officer (February 22).

The following (from Reserve) are granted short-service commissions as Pilot Officers on probation on the dates stated:—C. H. Robinson (March 7); R. Herrick, F. N. Lines (March 5); I. C. Chalmers (March 8).

The following are granted short-service commissions as Acting Pilot Officers on probation on the dates stated:—L. S. Adams, P. A. F. Addie, J. R. Anderson, J. F. E. Andrews, W. H. Arnold, J. K. Astin, E. N. Baker, S. T. Beal, B. E. Bell, J. R. Bellerby, D. G. Belyea, R. H. M. Bennett, L. G. Bishop, J. S. Booth, T. H. Borg-Banks, C. J. A. G. Brain, J. Brain, P. G. Brodie, J. N. Carter (from Reserve), A. C. P. Clayton, J. G. Cole, A. B. Corbett, D. C. F. Coutts, G. J. Cox, G. L. D. Cox, R. E. Cox, D. W. Coysh, M. A. Craig-Adams, G. G. Crawford, L. E. Cryderman, H. Davison, J. H. Day, C. H. Dearden, P. M. de Mestre, K. M. A. de Souza, P. G. Dexter, D. S. Dickins, G. D. Dillabough, J. A. Dixon, N. A. R. Doughty (from Reserve), A. W. Dunn, R. G. Egerton, V. G. W. Engström, J. Falkson, R. L. J. Fitch, J. M. Gilmer, F. R. Godsmark, J. O. Griffits, J. C. Hall, D. J. Harkness, J. Harrison-Broadley, J. S. Hart, A. R. G. Harvey, D. L. Harvey, G. B. Hawes, H. M. T. Heron, B. A. H. Hitchings, R. J. K. Hogg, D. F. S. Holbrook, D. W. Holford, R. A. Howley, J. G. Hughes, T. G. Hynes, K. Illingworth, K. C. H. Jacobs, H. O. Jones, E. J. Keeble, W. J. King, L. C. Kingsbury, I. R. Krohn, O. H. Launders, J. L. Leeds, A. S. Linney, C. M. Lochhead, I. F. McDermott, H. E. D. Marryat, P. W. Mason, C. Matheson, K. W. Michie, R. A. Mosley, N. J. Mowat, T. C. Musgrave, G. G. K. Nolan, L. M. O'Leary, A. C. Ollerenshaw, R. E. Packington, P. McL. Peace, T. A. Peeler, A. E. P. Pim, D. K. Plumb, F. H. Posener, C. P. D. Price, P. M. Procter, P. H. Purdy, K. C. Ritchie, J. D. Robertson, L. O. Rogers, R. M. Rogers, R. A. Rusell-Forbes, L. T. L. T. J. Ryan, G. K. Scott, D. Secretan, A. J. Simpson, G. L. Sinclair, M. E. R. Smith, B. W. Smithers, C. E. Staples, D. B. Starky, L. W. Stevens, W. H. Thallon, J. R. Thompson, H. W. Thorburn, J. D. True, N. W. Walders, C. J. R. Walker, P. R. B. Wanklyn, H. D. Wardle, D. M. Wellings, W. B. Wheelwright, A. G. Whitehead, Y. R. T. Williams, R. A. G. Willis, A. F. M. Wilson, P. Wyatt-Smith, C. R. Wylie (March 4); R. P. Earl (March 7).

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers on the dates stated:—D. C. Hellard (November 29, 1938); A. V. Gowers (February 19); F. R. Graeme-Evans (March 4); D. N. W. L. Anthony (March 7).

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation (March 7):—C. R. Hattersley, J. C. Mackintosh, Sir R. A. MacRobert, Bt., R. Stevenson.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—F. O. Dickson (January 27); J. Fulton (March 7); L. J. Stickley (A./Flt. Lieutenant) (March 14).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—K. W. C. Bindloss (January 3); R. R. Helsby, D. P. Bamber (Acting Flying Officer) (January 29); R. J. Kelsey (February 3); C. A. Vernieux (February 10); R. N. Belgrove (February 11); R. N. Bateson (Acting Flying Officer) (February 13); B. A. Miller (February 15); E. N. Ryder, R. H. Thompson, E. D. Chantler (February 24); R. E. G. Morewood (March 8); R. D. Williams, E. D. Godfrey (Acting Flying Officer) (March 17).

Wing Cdr. H. W. L. Saunders, M.C., D.F.C., M.M., is granted the acting rank of Group Captain (paid) while seconded for duty with the New Zealand Government (February 25); F/O. J. C. McG. Lunn relinquishes the acting rank of Flight Lieutenant (March 3); Lt. J. N. Garnett, R.N., is reattached to the Royal Air Force as a Flight Lieutenant with effect from March 7 and with seniority of January 1, 1936; Lt. Cdr. C. A. Kingsley-Rowe, R.N., Squadron Leader, R.A.F., ceases to be attached to the Royal Air Force with effect from February 11 on return to Naval duty, and is reattached to the Royal Air Force as a Squadron Leader with effect from March 10 and with seniority of January 1, 1938; P/O. J. W. Lecky takes rank and precedence as if his appointment as Pilot Officer bore date February 9, reduction to take effect from February 9; Flt. Lt. J. C. Northey relinquishes his short-service commission on appointment to a commission on the Unattached List for the Indian Army (March 3).

Equipment Branch

Flying Officer on probation G. B. Lewis is confirmed in his appointment (January 10); F/O. S. G. Walker is granted the acting rank of Flight Lieutenant (February 1).

The short-service commissions of the following Acting Pilot Officers on probation are terminated on cessation of duty (March 11):—E. W. Magahy, G. L. Schwind, G. W. Sweeting.

Medical Branch

Flt. Lt. W. P. Stamm, M.B., B.S., M.R.C.S., L.R.C.P., is granted a permanent commission in that rank (January 8).

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

Lt. Cdr. G. L. Woodbridge (R.N., Ret.) is granted an honorary commission in Class C as Flying Officer (January 26).

The following are granted commissions in Class CC as Flight Lieutenants on the dates stated:—Capt. W. H. Brett (Su. U.L., I.A.), Maj. C. E. W. Kennedy (Sp. U.L., I.A.) (January 2); Maj. A. G. Adams (Sp. U.L., I.A.) (January 5); V. A. Watkins (January 14); Maj. G. S. Jarman (Sp. U.L., I.A.) (January 30); G. R. C. Brook (February 13).

Flt. Lt. E. H. Wheelwright is transferred from Class A to Class C (January 10); F/O. E. P. Swallow is transferred from Class AA to Class C (November 23, 1938).

The following relinquish their commissions with effect from September 27, 1938, on appointment to commissions in the Royal Air Force Volunteer Reserve and are reappointed to the Reserve of Air Force Officers with effect from October 12, 1938:—Flt. Lt. J. R. Stewart, F/O. G. D. H. Ross.

F/O. G. J. Powell relinquishes his commission on completion of service and is permitted to retain his rank (September 16, 1938); F/O. H. Lyne relinquishes his commission on completion of service and is permitted to retain his rank (December 16, 1938).

The following Pilot Officers relinquish their commissions on appointment to short-service commissions in the Royal Air Force:—C. H. Robinson (March 7); I. C. Chalmers (March 8).

The following Acting Pilot Officers on probation relinquish their commissions on appointment to short-service commissions in the Royal Air Force (March 5):—R. Herrick, F. N. Lines.

The commission of Acting Pilot Officer on probation R. T. Golden is terminated on cessation of duty (March 9).

Royal Air Force Volunteer Reserve

General Duties Branch

Flt. Lt. W. H. N. Shakespeare, M.C., A.F.C., is appointed Honorary Flight Lieutenant (January 23); Capt. D. R. Ritchie (R.N., Ret.) is appointed Honorary Flight Lieutenant (February 2).

The following Pilot Officers relinquish their commissions on appointment to short-service commissions in the Royal Air Force (March 4):—J. N. Carter, N. A. R. Doughty.

Administrative and Special Duties Branch

The following are granted commissions as Pilot Officers on probation (March 14):—V. C. S. Bach, D. C. Baillie, M. W. Baseden, G. E. R. Baxter, H. M. Bentley, H. B. Dent, J. S. Dykes, H. G. D. Ereckson, C. R. Finch-Noyes, D.S.O., A.F.C., R. A. Foggin, R. M. Freshwater, B. G. Groner, F. H. D. Hitch, S. Horscroft, M.C., H. M. Matthews, E. L. Moxey, C. A. J. Plant, D. N. Reid, E. M. Selby, O.B.E., W. M. F. Sherwood, J. V. Southon, J. W. Sparrow, M.M., J. A. Stedman, W. A. Villiers.

Equipment Branch

The following are granted commissions as Flight Lieutenants with effect from September 27, 1938, and relinquish these commissions with effect from October 12, 1938:—Flt. Lt. J. G. Murray, Flt. Lt. E. E. Ellison (R.A.F.O.), J. W. Martin, Flt. Lt. D. W. Morrish (R.A.F.O.), A. W. Shaw, Flt. Lt. F. T. Stacey (R.A.F.O.), E. M. Thompson, Lt. G. D. H. Ross, Col. J. R. Stewart, T.D. (T.A.R.O.).

Medical Branch

G. D. Dawson, M.B., Ch.B., is granted a commission as Flying Officer (March 7). (Substituted for notification of March 7.)

The following are granted commissions as Flying Officers (March 21):—J. V. Quinn, L.R.C.P. and S., T. D. Spencer, M.R.C.S., L.R.C.P., A. F. W. Anglin, M.D, L.M.S.

Auxiliary Air Force

General Duties Branch

The following Flight Lieutenants relinquish their commissions with effect from September 27, 1938, on appointment to commissions in the Royal Air Force Volunteer Reserve and are reappointed to the Auxiliary Air Force with effect from October 12, 1938:—E. E. Ellison, J. W. Martin, D. W. Morrish, J. G. Murray, A. W. Shaw, F. T. Stacey, E. M. Thompson.

No. 502 (ULSTER) SQUADRON.—G. A. B. Johnston is granted a commission as Acting Pilot Officer (February 24); P/O. Thomas Mitchell Palmer relinquishes his commission (January 20).

No. 601 (COUNTY OF LONDON) SQUADRON.—The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—W. H. Rhodes-Moorhouse (January 29); H. J. Riddle (January 31).

No. 604 (COUNTY OF MIDDLESEX) SQUADRON.—Pilot Officer R. H. Scott is promoted to the rank of Flying Officer (October 16, 1938).

No. 605 (COUNTY OF WARWICK) SQUADRON.—P/O. N. Forbes is promoted to the rank of Flying Officer (December 17, 1938).

No. 903 (COUNTY OF LONDON) (BALLOON) SQUADRON.—R. R. Goding is granted a commmission as Flying Officer (November 4, 1938).

No. 909 (COUNTY OF ESSEX) (BALLOON) SQUADRON.—Sir T. F. Buxton, Bt., is granted a commission as Flight Lieutenant (February 15).

No. 924 (EAST LANCASHIRE) (BALLOON) SQUADRON.—The following are granted commissions as Acting Pilot Officers (February 16):—C. S. J. Palmer, W. E. Ballard, R. C. Hawkins.

No. 935 (COUNTY OF GLAMORGAN) (BALLOON) SQUADRON.—A. H. P. Noel is granted a commission as Acting Pilot Officer (February 28).

Equipment Branch

Flt. Lt. L. F. Caunter (R.A.F.O.) relinquishes his commission on cessation of duty (December 2, 1938).

THE ROYAL AERO CLUB

News and Official Notices for the Week Ended March 25

King's Cup Regulations

PRELIMINARY regulations for the King's Cup Race, provisionally fixed for September 2 or 9, have been issued by the Royal Aero Club. They are set out elsewhere in this issue.

Is it Enough?

INFERENCES drawn from the figures compiled last month are that during the present year Britain's civil air pilot strength will be increasing at the average rate of one for every 10,000 human beings in the population. During the past 28 days, 256 new Aviators' Certificates have been issued by the Royal Aero Club, which is the highest monthly figure ever recorded in British air history. It is an increase rate equivalent to 3,328 pilots in the year and there are signs of considerable further acceleration. Every day more than nine new civil pilots are certified by the Royal Aero Club. For the whole of last year the total number was 1,172 and in 1937 the figure was 981.

Landing "Seasons"

THE possibility of season tickets for civil pilots, to cover landing fees at all aerodromes, was discussed at a recent meeting of the General Council of Associated Light Aeroplane Clubs, and also at a meeting of The Committee of the Royal Aero Club this week. In brief, the plan would enable aeroplane owners and club members to avoid paying individual landing fees after the payment of a consolidated fee. It is believed that lower rates could be offered on this system than are possible by the individual payment method, and aerodrome owners will be consulted as to their views on the practicability of the suggestion.

On the Air Routes

FRANCE.—A danger area, of 4 *km.* radius, will be established until August 31 at *Epagny*, 15 *km.* north of *Dijon*. In addition, landing in the centre of *Dijon* aerodrome is temporarily forbidden and special regulations regarding landing and taking-off are in force in the space remaining available. A starter is present to regulate taking-off, but caution should be exercised when landing or taxying on the strips remaining available on the N., S. and E. sides.

Until March 31 a balloon may be flown at night up to 1,000 *m*, within a 3 *km.* radius of the centre of *Compiègne*.

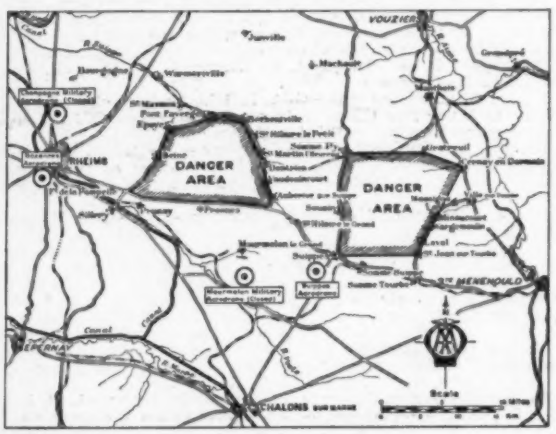
Suippes (*Marne*).—Danger areas in which firing will take place from March 15 to October 31 have been defined. A map prepared by the Aviation Department of the Automobile Association is reproduced on this page.

GERMANY.—A broadcast from Berlin announces that the "air space" above the Protectorates of *Bohemia* and *Moravia* is closed to all aircraft. A later broadcast also prohibits aircraft from landing in or flying over *Memel* territory, with the exception of those operating regular services.

HOLLAND.—*Oostvoorne* aerodrome has been withdrawn from service.

POLAND.—*Nowy Targ* aerodrome is closed.

SWITZERLAND.—Day and night balloon barrage exercises will take place up to March 31 in the neighbourhood of Lake Lucerne. The area is delimited by *Emetten-Schwalmis-Wolfenschiessen-Arnigrat-Sarnen-Horw-Vitznau*.



The Marne danger areas referred to above.

Aviators' Certificates

No.	Name	Club or School	Date
17,366	Norman Hart Lynedoch Pringle	Edinburgh Flying Club ...	6.3.39
17,367	Donald Richard Clarence Whitcombe.	Kent Flying Club ...	16.3.39
17,368	Reginald Arthur Pearce... ...	Midland Bank Flying Club	6.3.39
17,369	Joseph Baxter Ellis	Cotswold Aero Club ...	12.3.39
17,370	Harold Patrick Aiken	Bournemouth Flying Club	17.3.39
17,371	Anthony Horace Milward ...	Lancashire Aero Club ...	16.3.39
17,372	James Landale Melville	Cinque Ports Flying Club	14.3.39
17,373	John Patrick Billington... ...	Cinque Ports Flying Club	17.3.39
17,374	Rex Arthur Dunster	Cinque Ports Flying Club	17.3.39
17,375	Peter Cecil Eustace Cox... ...	Ipswich Aero Club ...	4.3.39
17,376	James Douglas Alston	Norfolk and Norwich Aero Club.	18.3.39
17,377	Raymond Cecil Kemp	Kent Flying Club ...	17.3.39
17,378	John Barker Churchill Jago ...	Plymouth and District Aero Club.	16.3.39
17,379	James Calver	Newcastle-on-Tyne Aero Club.	19.3.39
17,380	Stanley Herbert Vinter	Southend Flying Club ...	19.3.39
17,381	Peter William Hewitt	Yorkshire Aeroplane Club	18.3.39
17,382	Benjamin Viggars	Hull Aero Club	18.3.39
17,383	Norman John Durrant	Bristol and Wessex Aeroplane Club.	18.3.39
17,384	John Strachan Ramsay	North British Aero Club...	4.3.39
17,385	Alexander Birrell Grosset ...	Strathtay Aero Club ...	19.3.39
17,386	Claude Humphreys	London Aeroplane Club ...	19.3.39
17,387	Charles Melville Beavis	London Aeroplane Club ...	20.3.39
17,388	Daniel Robert Cormack	Grimsby Aero Club ...	16.3.39
17,389	Robert Leech North	Grimsby Aero Club ...	16.3.39
17,390	Philip Fotheringham-Parker ...	Malling Aero Club ...	18.3.39
17,391	Leslie James Travis	County Flying Club ...	18.3.39
17,392	Cyril Hutton Tytherleigh ...	Airwork Flying Club ...	16.3.39
17,393	Ralph William Jones	Portsmouth Aero Club ...	19.3.39
17,394	Francis Ronald Wellburn ...	Hull Aero Club	12.3.39
17,395	William Hayward Budd... ...	Bournemouth Flying Club	20.3.39
17,396	Robert Hawley Harrison ...	Bournemouth Flying Club	20.3.39
17,397	Anthony Douglas Saunders ...	Romford Flying Club ...	20.3.39
17,398	John Lewis Baines	Leicestershire Aero Club	18.3.39
17,399	Henry Stanley Foulds	Thanet Aero Club ...	20.3.39
17,400	Dora Tilly	London Air Park Flying Club.	20.3.39
17,401	Stuart Morgan Farrington ...	London Air Park Flying Club.	20.3.39
17,402	Brenda Marjorie Holeman-Rowdon.	London Air Park Flying Club.	21.3.39
17,403	Gwladys Ellen Evans	Cardiff Aeroplane Club ...	19.3.39
17,404	Thomas Alfred Sangster... ...	Coventry Aeroplane Club	9.3.39
17,405	Guy Herbert Ashenden	Redhill Flying Club ...	1.3.39
17,406	George Julius Konried	Redhill Flying Club ...	18.3.39
17,407	Peter Clement Vellacott Joslin...	Redhill Flying Club ...	9.3.39
17,408	Diana Kemp	Yapton Aero Club ...	15.3.39
17,409	Michael Burton Stewart... ...	Airwork Flying Club ...	4.3.39
17,410	Iwo Murray Parker	Airwork Flying Club ...	19.3.39
17,411	Reginald Victor Mount	Kent Flying Club ...	18.3.39
17,412	Arthur Ernest Staddon Matthews	Airwork Flying Club ...	17.3.39
17,413	Richard George Stafford ...	Leicestershire Aero Club...	18.3.39
17,414	Louis Ball...	North Staffs Aero Club ...	28.2.39
17,415	James Henry Simpson	North Staffs Aero Club ...	19.3.39
17,416	Frederick Newbold Jenkinson ...	North Staffs Aero Club ...	19.3.39
17,417	Ronald Forbes Pearson	Scottish Flying Club ...	19.3.39
17,418	William McMaster Scarlett ...	Scottish Flying Club ...	12.3.39
17,419	Evelyn O. de Seversky	Ipswich Aero Club ...	20.3.39
17,420	Alexander P. de Seversky ...	Ipswich Aero Club ...	20.3.39
17,421	Ernest Arthur Lingard	Grimsby Aero Club ...	20.3.39
17,422	Frank Donald Scott	Midland Aero Club ...	19.3.39
17,423	Norman Arthur Kynaston ...	Midland Aero Club ...	19.3.39
17,424	William Stanley Law	Midland Aero Club ...	19.3.39
17,425	Herbert Rowdon Collins ...	Marshall's Flying School	16.3.39
17,426	Henry Antony Francis Trew ...	Johannesburg Light Plane Club, S. Africa.	21.3.39
17,427	Harold Valentine Ellis	Cotswold Aero Club ...	21.3.39
17,428	Florence Jean Miller	London Aeroplane Club ...	18.3.39
17,429	Peter Reginald Fenson	London Aeroplane Club ...	9.3.39
17,430	Gerald Bertram Crothers Sumner	Brooklands Flying Club ...	21.3.39
17,431	Joseph Wilfred Simpson ...	Grimsby Aero Club ...	20.3.39
17,432	Raymond Allen	Grimsby Aero Club ...	19.3.39
17,433	James William Middleton ...	Grimsby Aero Club ...	20.3.39
17,434	John Foster Ingham	Exeter Aero Club ...	13.3.39
17,435	Samuel George Tolman	Exeter Aero Club ...	11.3.39
17,436	Leslie Victor Davis	Thanet Aero Club ...	20.3.39
17,437	Geoffrey Gerald Wright	Southend Flying Club ...	22.3.39
17,438	Eric Smith	Tollerton Aero Club ...	19.3.39
17,439	Ernest Benjamin Gudgeon ...	Tollerton Aero Club ...	19.3.39
17,440	Arthur Barnes	Tollerton Aero Club ...	19.3.39
17,441	Archibald David Smith	Tollerton Aero Club ...	15.3.39
17,442	Charles Herbert Hamilton ...	Tollerton Aero Club ...	14.3.39
17,443	Elizabeth Robina Webster ...	Tollerton Aero Club ...	14.3.39

ARMSTRONG WHITWORTH

WHITLEY

HEAVY BOMBERS

Designed and Constructed by

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED WHITLEY, COVENTRY, ENGLAND

Branch of Hawker Siddeley Aircraft Co. Ltd.

RUGOJARSKY Ltd.
IK-3
BEOGRAD / YUGOSLAVIA

ARMAMENT

Some Notes on Recent Developments : Large-bore Shell-guns : Installations and Turrets

THE data available on modern aircraft armament relates chiefly to guns, and it is to these weapons that this brief study will be mainly devoted.

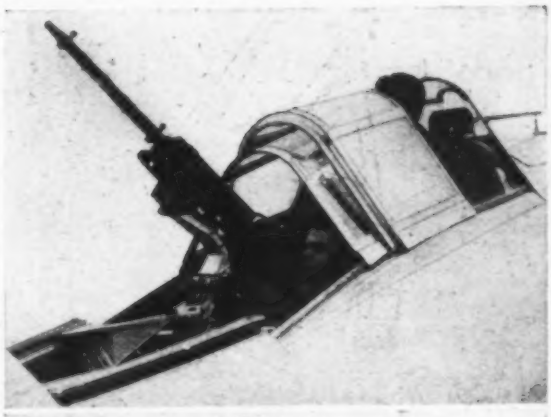
Bombs, of course, are constantly being improved, though there is a general feeling that they are still unwarrantedly crude. Varieties in use include high-explosive, armour-piercing, fragmentation, anti-submarine, incendiary, thermite, chemical, gas and anti-aircraft. The last-named variety, although strange to this country, have been developed abroad, particularly in America, for attacking large bombers. There have been reports of aerial mine laying and of unorthodox types of bombs for destroying ships. "Glider" bombs (with a reasonably long horizontal range) have been suggested and the use of mortars from aircraft visualised, but no references to full-scale experiments have yet been published.

Bomb sights and facilities for aiming have been greatly improved of late, and since the introduction of internal stowage there has been more intensive application to problems of stowage and release. Torpedoes are being developed along normal lines.

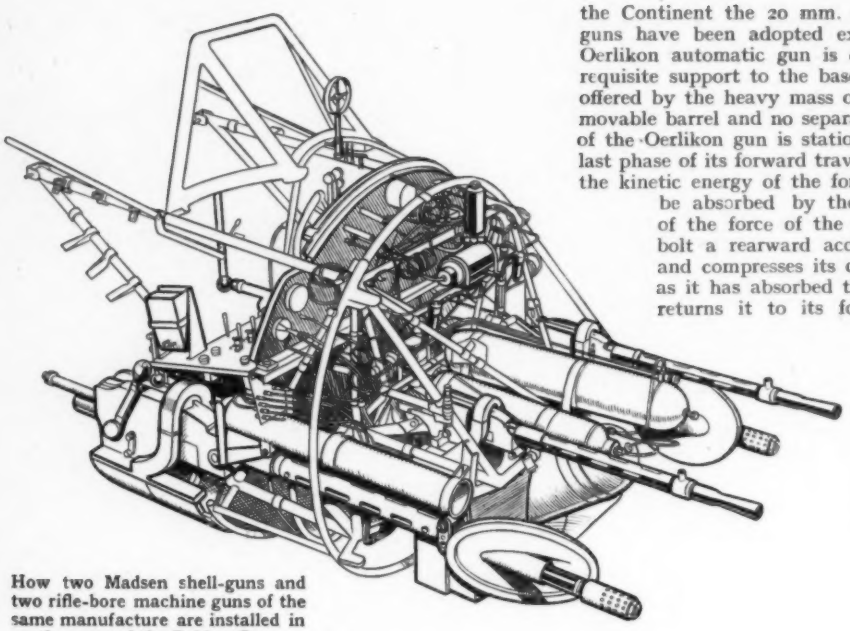
Guns and Their Makers

Aircraft guns range from rifle-calibre weapons (6.5-8 mm.) produced by the Vickers, Browning (Colt), F.N.-Browning, Darne, Chatelleraut, Breda Safat and Madsen factories, to shell-firing guns (*canons*) made by Madsen, Oerlikon, Hispano Suiza, Hotchkiss, the American Armament Corporation and the Ordnance Corps of the U.S. Army.

Typical of the rifle-calibre machine guns is the Madsen, developed from an infantry weapon firing at the rate of 450-500 rounds a minute. A recoil increaser and a special recoil spring brings the rate of fire up to 1,000-1,200 rounds a minute. Cartridges are fed into the gun by means of metal links held together by the cartridges themselves. In fixed installations the belt is placed in the cartridge box somewhere near the gun and shaped to suit the space available and the number of rounds required. In turrets



On the right are three views showing free-gun installations on American, German and British two-seaters. From top to bottom are the Seversky amphibian fighter, a German observation machine and the Hawker Demon (Turret) two-seater fighter which will remain our standard machine in this class until the introduction of Defiants. Below are armourers installing the R.A.F. model of the Browning gun on a Gloster Gladiator and (bottom right) the installation of a Browning gun in the wing of an American Waco. Hurricanes and Spitfires, for the time being, have eight fixed Brownings apiece.



How two Madsen shell-guns and two rifle-bore machine guns of the same manufacture are installed in the nose of the Fokker G. 1.

and other free installations the belts would be placed in boxes (normally for 80-100 rounds) with means of quick replacement. Cartridges available are of the steel-cored, tracer, smoke-tracer and armour-piercing variety. The gun is of the air-cooled fully automatic type, the action comprising a backward and forward movement of the recoiling portions within the fixed part of the weapon; the motion is actuated by the gases of the explosion and a system of springs.

Belt-fed guns are now generally more extensively used than the drum-fed type, though the latter has a good deal to recommend it, particularly in free installations.

Machine guns of heavier calibre (0.5in.) are used by some countries, but have never met with any great popularity, though it has been customary to fit certain types of American fighters with one gun of this sort alongside a rifle-calibre weapon. It scores over the smaller bore gun in that its bullet has a flatter path up to the ranges of 600 or 700ft., though the rate of fire is much lower.

Current types of shell-guns are of 20-37 mm. bore. On the Continent the 20 mm. Oerlikon and Hispano shell-guns have been adopted extensively. The bolt of the Oerlikon automatic gun is of the non-locking type, the requisite support to the base of the cartridge shell being offered by the heavy mass of the bolt. Thus there is no movable barrel and no separate locking lever. The barrel of the Oerlikon gun is stationary. The bolt, in the very last phase of its forward travel, fires the cartridge, so that the kinetic energy of the forward flying bolt has first to be absorbed by the explosion before the rest of the force of the explosion can impart to the bolt a rearward acceleration. The bolt recedes and compresses its closing spring which, as soon as it has absorbed the recoil energy of the bolt, returns it to its forward position. The bolt, together with its return spring, constitutes the whole automatic repeating mechanism. It is claimed that an automatic bolt system of this sort, in which there are no shocks caused by unlocking and locking movements, is particularly suited for aircraft units. Three Oerlikon models have been developed and all can be used from free mountings or turrets.

Their characteristics are normally:—

	Muzzle Velocity	Rate of Fire	Weight
Model "F"	600 m/sec.	520/min.	23 kg.
" "L"	750 "	450 "	30 "
" "S"	900 "	400 "	39 "

The so-called *moteur canon* produced by the Hispano Suiza concern embodies an Oerlikon-Hispano 20 mm. Model S shell-gun having a muzzle velocity of 830 metres/sec. and a rate of fire of about 300 rounds a minute. The gun is mounted between the cylinder blocks of a vee-twelve engine and is firmly anchored so that the mass of the power plant helps to absorb the recoil shocks.

A number of single-seater fighters now mount shell-guns of 20-23 mm. bore in their wings, while twin-engined machines are particularly suited for nose mounting. In many instances the guns adopted for these purposes are of Madsen design, being based on the small-bore machine gun to which reference has already been made. The Madsen Company claims that its 23 mm. gun, although weighing little more than a 20 mm. model, is capable of firing shells with double the explosive force. Being fed by a belt and not by a drum it is practicable to carry a large supply of shells. It is possible to fire the gun incessantly as long as ammunition lasts. The explosive shells used may be of the tracer variety and are fitted with highly sensitive fuses which cause an explosion ten seconds after discharge, so that if no

Bombs about to be loaded into an American Douglas B-18 bomber. It will be seen that the bomb doors are already open to receive the projectiles.

hit is made friendly personnel on the ground will not suffer.

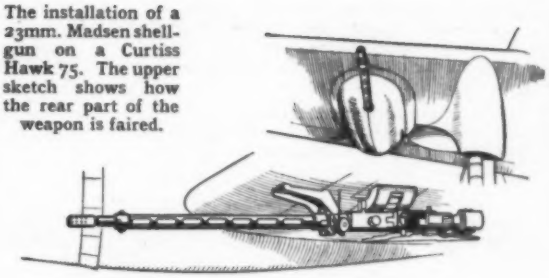
The American Armament Corporation (represented in this country by W. S. Shackleton, Ltd.) have produced 37 mm. guns for aircraft use, possessing, it is claimed, a number of advantages over the smaller types, apart from greater destructive power. For example, provision is made so that a shell cannot explode prematurely either in the barrel of the gun, in the process of the automatic functioning of the gun or in the handling of the ammunition. Although the shell is equipped with a super-sensitive nose fuse, which will cause an explosion on contact with even the lightest fabric, there is carried, in the fuse itself, a device which makes the ammunition bore-safe and detonator-safe. This means that if the detonator in the fuse should explode through shock the charge in the shell will not be fired.

The 37 mm. A.A.C. gun is available in two types—the type M (movable) is of 20 calibres length and is designed for a free installation, while the type F (fixed) is a 50-calibre gun for use from a fixed mounting.

Data

The short gun has the following characteristics: length of recoil, 10in.; rate of fire, 100 rounds a minute; weight of gun, ready for installation, 250 lb.; recoil pull, 1,000 lb.; weight of high explosive shell, 1.1 lb.; weight of clip with five rounds, 8.2 lb.; and muzzle velocity, 1,250 ft./sec. The type F gun has the following characteristics: muzzle velocity, 2,700 ft./sec.; length of recoil, 15in.; recoil pull, 1,700 lb.; weight of gun without supports, 440 lb.; maximum rate of fire, 90 rounds a minute; overall length, 100in. The manufacturers are believed to be developing a 75 mm. gun for aircraft use.

The installation of guns in aircraft presents problems almost as difficult as those associated with the design of the guns. In fixed machine gun installations there are usually one to eight belt-fed guns. Wing mounting is favoured in single-engined types because synchronising gear is rendered unnecessary and the rate of fire is not limited by engine speed. Twin-engined machines, as demonstrated in the Fokker G-1, can accommodate a battery of guns in the nose and fuselage, though staggering is necessary to permit feeding. The problems of heating for high-altitude flying have lately proved troublesome in certain installations of multiple machine guns.



The installation of a 23mm. Madsen shell-gun on a Curtiss Hawk 75. The upper sketch shows how the rear part of the weapon is faired.

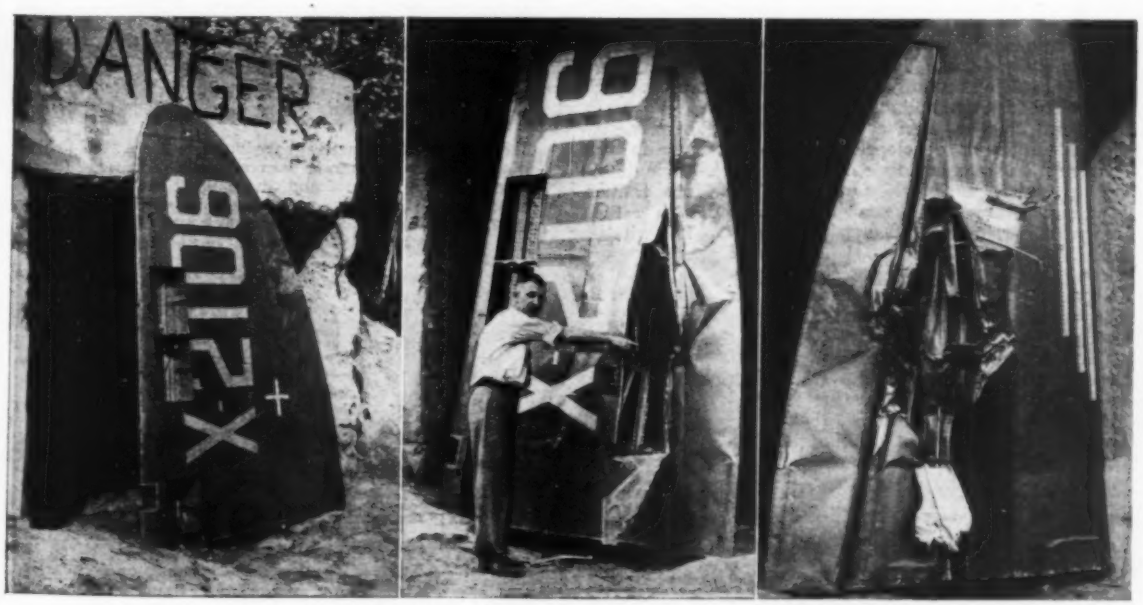
Shell-guns are similarly installed, though an alternative arrangement is the Hispano *moteur canon* already mentioned. In view of the competition offered by independently mounted shell-guns it may be that the Hispano *moteur canon* will be developed to house guns of larger bore than the present 20 mm. model built under Oerlikon licence. If it is correct that a 37 mm. gun has been installed on the American Curtiss P-37 Allison-engined single-seater fighter it would seem that the U.S. Army is interesting itself in a similar arrangement.

A 37 mm. gun fired by compressed air is visualised for installation in the little Payen Flechair single-seater being constructed in France.

Turrets

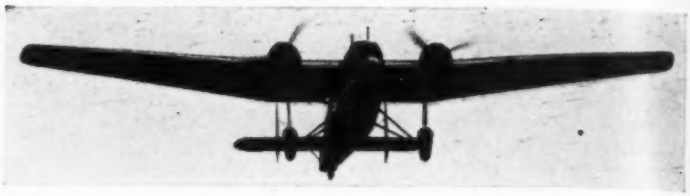
The power-driven turrets developed to house batteries of small-bore machine guns are likely to be adopted in strengthened form to house shell-guns. The short A.A.C. weapon is normally supplied with a rotating turret which is traversed by gearing operated by a hand-wheel. A second hand-wheel controls elevation and the gun is fired with the left foot, the right foot controlling the traversing brake. The sight is at right-angles to the bore of the gun. It would seem that power operation is desirable for such an installation, and a turret embodying this feature has been produced experimentally by the manufacturers.

The Nash and Thompson turrets supplied to the R.A.F. are equipped with heating devices, inter-communication 'phones, gun heating, oxygen, and lighting for a reflector sight.

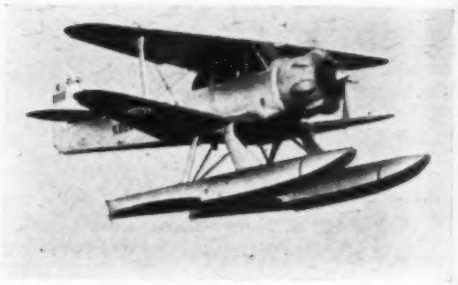


The American Armament Corporation has developed a 37 mm. shell-gun which has great destructive power. This Seversky wing demonstrates the effect of one of the shells. From left to right are the wing intact (showing the aiming mark); the point of entry; and the exit.

One of the first views (right) of the production-type Bristol Bombay as standardised by the R.A.F. for bomber-transport duties. It is built in the Short and Harland factory at Belfast.



To meet the requirements of the U.S. Army Air Corps a special version of the Lockheed 14 (below) has been developed as a military transport. The hump on the fuselage is a characteristic feature.



Military Aircraft—V

TRANSPORT, TARGET and COMMUNICATION TYPES

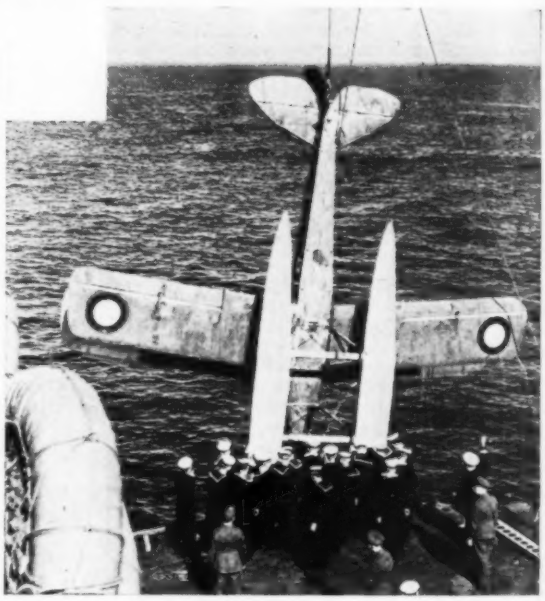
THE rapid transport of troops, engines, spare parts, ammunition, provisions and the like is being met by large multi-engined machines. In the R.A.F. these are known as bomber-transports, being able to function in either capacity, though America has so far favoured somewhat smaller machines, employing them purely for the high-speed transport of selected personnel and for the delivery of spare engines, etc.

The advent of the parachute corps in certain Continental air forces may demand even larger machines than the "pantechnicons" now in use.

Staff officers and other key personnel require fast machines for their personal transport. The types concerned are usually adaptations of standard civil designs and carry no armament, as their work would be done behind the lines, where they would have the protection of friendly fighters. Rotating-wing machines or other types capable of operation from confined spaces are specially suited for certain kinds of liaison work.

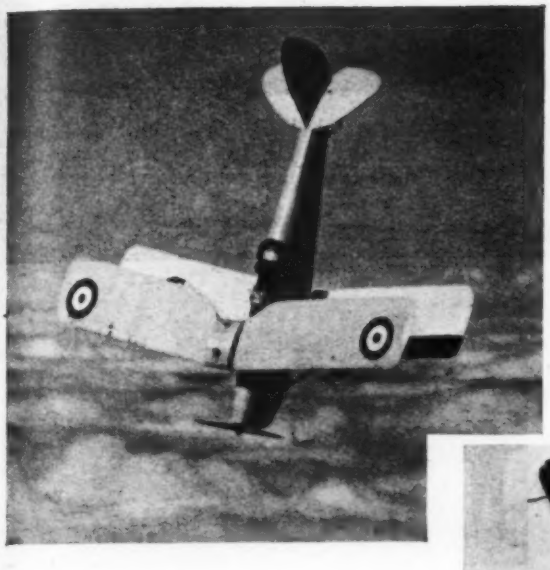
A third class of auxiliary aircraft is the wireless-controlled target, as developed almost exclusively in this country. The standard type in service is the De Havilland Queen Bee, a modification of the Tiger Moth trainer. Machines of this sort are usually employed with a float undercarriage, being launched by catapult. The wireless installation, which displaces the crew, is of a secret nature. More powerful, and possessing a higher performance, is the Cheetah-engined Queen Wasp, designed for similar functions.

That experience gained with these wireless-controlled targets will prove valuable in the development of crewless military aircraft is not to be doubted, though information on this subject is still of a highly confidential nature.

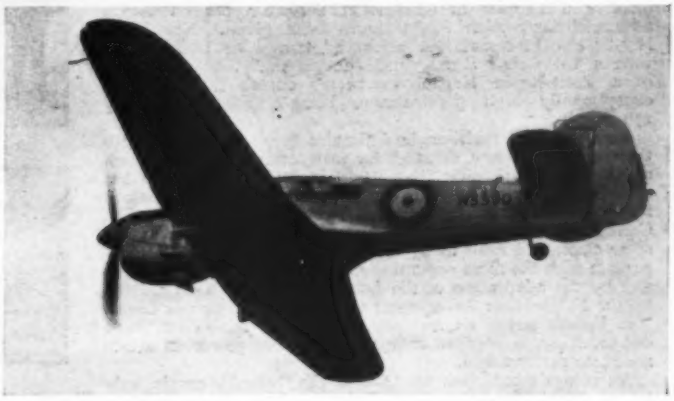


The two views immediately above illustrate the types of British wireless-controlled target aircraft—the Airspeed Queen Wasp and the De Havilland Queen Bee. The Queen Bee is being salvaged after a practice shoot by naval anti-aircraft guns. H.M.S. *Argus*, an obsolescent aircraft carrier, has been fitted out as a "mother ship" for these aircraft.

On the left is the De Havilland Don (D.H. Gipsyking engine) as employed for communication work and for certain types of training in the R.A.F. The Sikorsky amphibian, directly above, is a type used by the U.S. Army and Navy for general transport duties.



The De Havilland Tiger Moth, on the left, is a well-established type on which thousands of pilots have been trained and which is still in large-scale quantity production. Its influence on foreign design is exemplified by the Belgian Stampe-et-Vertongen S.V. 4-B, which has the same power plant—the Gipsy Major of 130 h.p. Below is the Rolls-Royce Kestrel-powered Miles Master, for advanced R.A.F. training.



Military Aircraft—VI

TRAINERS

THE expansion of an air force must inevitably give a fillip to development of training aircraft, and the past two or three years have seen not only the greatly increased production of proven instructional types, but the evolution of new varieties for specialised training duties.

It may be assumed that the modern air force will need small elementary (*ab initio*) types, advanced single-engined trainers and twin-engined machines, apart from a selection of marine aircraft, for instructional purposes. The marine craft need not be so specialised as the landplanes. The high speed, low-powered single-seater fighter trainer as typified by certain of the Caudron models has not yet gone into service in quantity.

Ab initio work demands economy, safety and stamina to withstand abuse. The monoplane has by no means displaced the biplane for this work. Parallel deliveries of De Havilland Tiger Moth biplanes (Gipsy Major) and Miles Magister monoplanes (Gipsy or Cirrus Major) are, in fact, being made for the R.A.F. Foreign tendencies in the same category also indicate that in at least one class the biplane has by no means been pushed out of the picture, though some highly efficient and elegant little monoplanes are making a good name for themselves.

Of late, the R.A.F. has been trying out prototype *ab initio* trainers which carry more equipment and are considerably heavier than preceding models, demanding 200 h.p. to secure a similar or slightly improved performance. It is likely that a good deal of the equipment requested in these machines will be deleted in future types. Already one *ab initio* trainer—the Parnall described in *Flight* last week—has been provided with full slot and flap equipment.

Retractable undercarriages and variable-pitch airscrews are not yet being favoured, though dummy control levers are sometimes fitted for instructional purposes.

America, and for that matter certain Continental powers, has always favoured rather higher-powered machines for initial instruction, pupils passing from these aircraft to "basic" trainers as represented by the North American NA-16, from which the Harvard, as used by the R.A.F., has been developed

Studies in perspective: Above are Stearman trainers of the U.S. Army Air Corps, and, on the right, are Miles Magisters before delivery from their manufacturer's Reading Aerodrome.

The German Bücker Jungmeister (160 h.p. Siemens) is one of the world's finest aerobatic machines. Italy's Meridionali Ro.41 (top right) is also very manœuvrable.

as a two-seater advanced trainer. The Harvard will help to displace a number of obsolescent Service types on which advanced instruction has hitherto been given. The Miles Master also represents the advanced two-seater trainer, and thanks to refined aerodynamic design and the installation of a Rolls-Royce Kestrel vee-twelve engine can show an exceptionally high performance, being capable of nearly 270 m.p.h.

Now that the multi-engined Service types have come into their own there is a demand for instructional aircraft which reproduce their peculiar characteristics. The Avro Anson has been extensively used for the work, though the Airspeed Oxford is now regarded as our standard twin-engined trainer. The German Focke-Wulf Weihe is an economical machine in the same class, and from many aspects is to be favoured in comparison with the more expensive stressed-skin types as exemplified by the adaptation of the Lockheed 12 (900 h.p.) ordered by the Netherlands Government and the U.S. Army Air Corps. The French *avion de travaille*, due to its somewhat crude design, likewise requires comparatively high power to attain adequate performance.

All things considered, we have in the Oxford a particularly happy machine, not only for pilot instruction but for the initiation of crews in the complexity of modern military aircraft.

The Bristol Blenheim is being used in certain R.A.F. units for practical instruction in the handling of twin-engined fighters, but by no stretch of the imagination could the Blenheim be said to be passed into the training category.

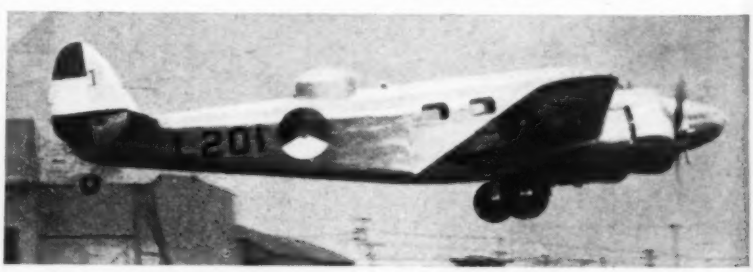
Long-range navigational training may demand the employment of first-line Service types, though, as this instruction will normally be given in the squadrons, these aircraft are not to be considered in the training category.

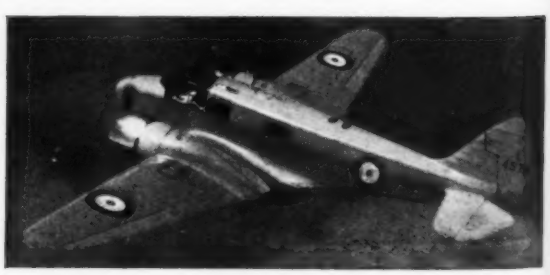
The De Havilland Don cabin monoplane is being issued to R.A.F. units for general communication and liaison work and for certain types of navigational and blind-flying instruction.

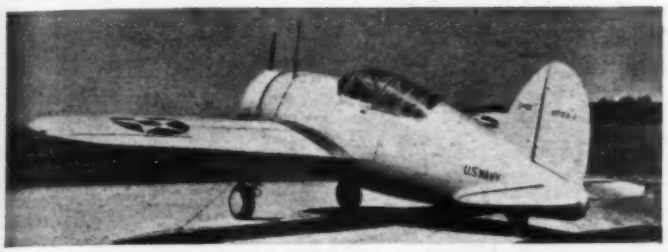
There will always be a demand for first-line, or obsolescent, Service types, and Fairey Battles are already being used for instructional work in the Reserve schools of the R.A.F.

The three views immediately above show, from top to bottom, the North American Harvard as used by the R.A.F., the Italian Nardi FN 305, and the German Arado Ar. 96. All three of these machines are intended for advanced training and are capable of maximum speeds of about 200 m.p.h.

An adaptation of the Lockheed 12 (right) has been produced for advanced twin-engine training. Below is the successful Focke-Wulf Weihe and (bottom right) the Airspeed Oxford — probably the finest machine of its kind in the world.







(Left) America has developed a single-seater shipboard fighter to a very high pitch. The machine illustrated is the Brewster F2A-1 now in production.

A number of biplanes in service with the U.S. Navy have retractable undercarriages, as illustrated by the Grumman F3-F2 single-seater fighter shown below.

Military Aircraft—VII

FLEET AIRCRAFT

THE greatest naval air arms of the world are possessed by America and Great Britain, and though the former has for long regarded her naval aviation as one of the major factors in national defence, Great Britain is only now expanding her Fleet Air Arm (Naval Air Branch) to the really powerful force which is unquestionably required. Comparisons between the two forces must be carefully considered, as the U.S. Navy controls a very powerful force of flying boats in addition to her ship-planes.

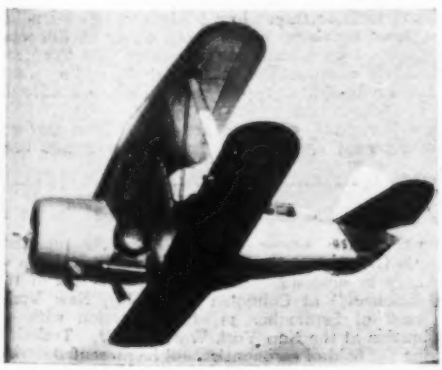
It is in the naval air arms of Great Britain and America that the design of Fleet aircraft may best be studied. Germany has no carrier ships yet in service, Italy does not favour such vessels and France and Japan, although possessing carriers, can demonstrate comparatively little worthy of study. Catapult aircraft are carried by the naval vessels of all the naval powers, but here, again, the U.S.A. and Great Britain have evolved the more advanced operational technique and more highly developed equipment than any other country.

Fleet aircraft can be categorised as deck-landing machines with wheel undercarriage, and flying boats, amphibians or floatplanes, designed for operation from other types of naval craft, usually through the medium of the launching catapult and hoisting derrick.

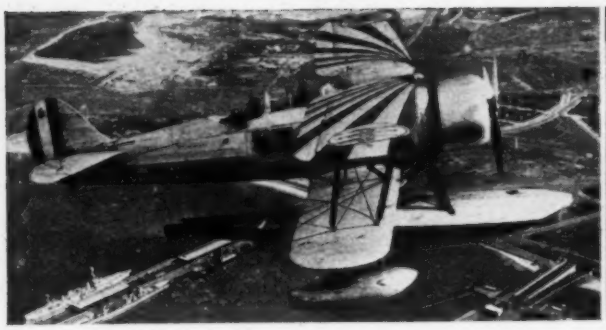
Carrier-based aircraft are generally of the fighter, spotter, reconnaissance, bomber, torpedo-carrier or utility (general purpose) types. Certain of the duties named are often covered by one specification, as exemplified by our T.S.R. (Torpedo Spotter Reconnaissance) class.

Although at one time it looked as though a single-seater fleet fighter would disappear on account of its limited range and lack of navigational facilities, the recent orders placed by the American and British Navies for Grumman, Brewster and Gloster types would indicate a new lease of life. While America is going in for the very fast mid-wing monoplanes with retractable undercarriage, the Gloster Sea Gladiator is based on the well-known Gladiator for land service and should do excellent work as an interim type.

There is, however, one monoplane already in service with the Fleet Air Arm which can function as a fighter. This is the Blackburn Skua two-seater fleet-fighter dive-bomber with



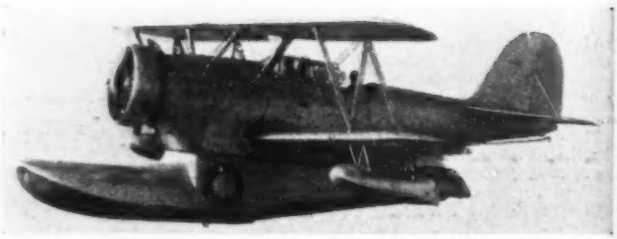
The three views above are illustrative of modern dive-bomber design. The machines are the Blackburn Skua (Bristol Perseus) which can be used as a two-seater fighter; the Douglas BT-1 (Twin Wasp Junior); and the Brewster XSBA-1 (Wright Cyclone). On the left is the Curtiss SBC-3 which is similar to the export model Helldiver 77.



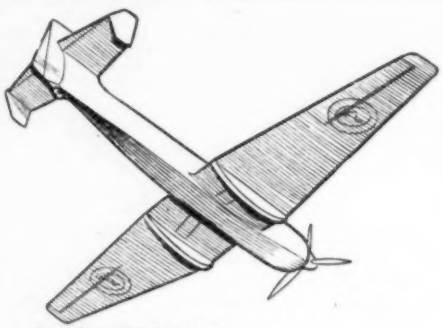
Italian and American technique in the design of two-seater catapult floatplanes is illustrated by the Meridionali Ro 37 (left, above) and the Curtiss SOC-1 (right, above).

Bristol Perseus radial engine. Comparable types of the U.S Navy are the Vought and Douglas two-seater dive-bombers (Twin Wasp Junior), which are of a more specialised kind and probably carry a heavier bomb load than does the Skua. It is believed that in order to keep the diving speed within reasonable limits the U.S. Navy is fostering not only the reversible-pitch airscrew, but also double-split trailing-edge flaps. Not only are these being used on the monoplanes mentioned, but on the 235-m.p.h. Curtiss SBC biplane dive-bombers. A number of single-seater dive-bombers are still in use in the U.S. Navy; France has also developed the type.

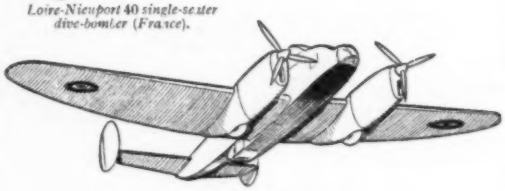
The most advanced ship-board torpedo carrier yet in service is the Douglas TBD-1, which has a single Twin Wasp engine and carries its torpedo internally. The greatest problem connected with machines of this description is not so much their ability to operate from a carrier's deck, but the question of stowage and the development of suitable wing-folding arrangements. The Blackburn Shark and Fairey Swordfish T.S.R. remain the standard torpedo carriers of our own Fleet Air Arm, although mention has been made of the Albacore and an even more advanced type to supersede these well-tried biplanes.



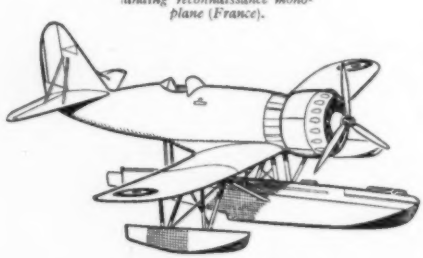
The Douglas TBD-1 (centre) is a two-seater torpedo-carrier in service with the U.S. Navy. The projectile is stowed internally. Below the Douglas is the Grumman J2F-1 "utility amphibian," which can be used for deck landing.



Loire-Nieuport 40 single-seater dive-bomber (France).



Projected Dewoitine D.750 deck-landing reconnaissance monoplane (France).



Loire-Nieuport 210 seaplane fighter (France).

The Supermarine Walrus (Great Britain) and the Grumman "Utility" (U.S.A.) are the most successful examples of heavy deck-landing machines which can also operate from water or land. The development of such aircraft reflects great credit on their designers; the amphibian in any case is a difficult enough type to plan, but when deck-landing gear and stressing for catapulting are also demanded the problems involved assume formidable proportions.

In comparison with corresponding landplanes, deck-landing aircraft must have provision for flotation either in the form of a water-tight fuselage or airbags, an arrester hook to engage with the transverse wires on the carrier's deck, folding wings (except in the small fighter types) and all-round ability to "take it."

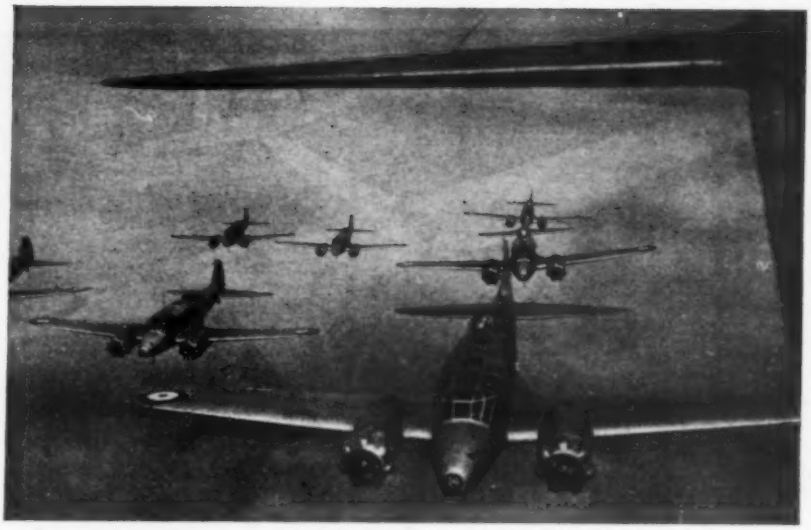
So far no twin-engined machines are in use from carriers, though their eventual employment has by no means been overlooked.

Aviation Congress in the States

THE Institute of the Aeronautical Sciences, the president of which is Dr. George W. Lewis, director of research of the N.A.C.A., is to hold an "International Congress of the Aeronautical Sciences" at Columbia University, New York, during the week of September 11, in connection with an aviation celebration at the New York World's Fair. Technical papers covering the field of aeronautics will be presented during the week.

Military Aircraft—VIII

COASTAL DEFENCE



Avro Anson reconnaissance machines of the R.A.F. The Anson has prepared the way for the adoption of more powerful machines for coastal defence duties.

RECONNAISSANCE machines, bombers and torpedo carriers are the classes of aircraft under development for coastal defence and for operation over the narrow seas. Flying boats, which can undertake any or all of the duties for which these machines are designed, will be considered separately.

Although for some years the Avro Anson monoplane with two 350 h.p. Siddeley Cheetah engines has been our standard coastal reconnaissance aircraft (under the R.A.F. classification "General Reconnaissance"), the introduction of more powerful types is imminent. The Anson (actually one of the most successful machines of its calibre ever designed) is handicapped chiefly by its inability to carry a big armament load. Its top speed is 188 m.p.h. The only replacement machine so far announced is the American-built Lockheed Hudson (Type 14M), developed, like the Anson, from a successful commercial design. It is known that the Hudson, which is powered with two 850 h.p. Wright Cyclone engines, can carry a big bomb load, though no mention has been made of a torpedo. The fact that camouflage has been applied to the Hudson emphasises that over-land bombing could easily be undertaken.

A "universal" coastal-defence machine capable of making long reconnaissance flights or of dropping bombs or torpedoes suggests itself. Machines of this description are, in fact, being developed abroad, though they are commonly of the floatplane variety for operation from comparatively sheltered waters. Such machines are the French Amiots and Liorés, the Italian Cant and the American Hall. Fokker has developed an interesting type for the defence of Holland's colonial possessions. This is known as the T.8-W, and although of comparatively low power (two 450 h.p. Wright Whirlwinds) could handle a full-size torpedo which would be stowed internally and released through hydraulically operated trap doors.

Although for many years British flying boats have been fitted to *transport* torpedoes, release gear has never been fitted as standard, though experiments have been made with carrying two "tinfish," one beneath each wing. The large twin-engined torpedo carrier is often condemned because of size and inability to manœuvre like a smaller machine in order to deceive opposing anti-aircraft guns mounted on surface vessels.

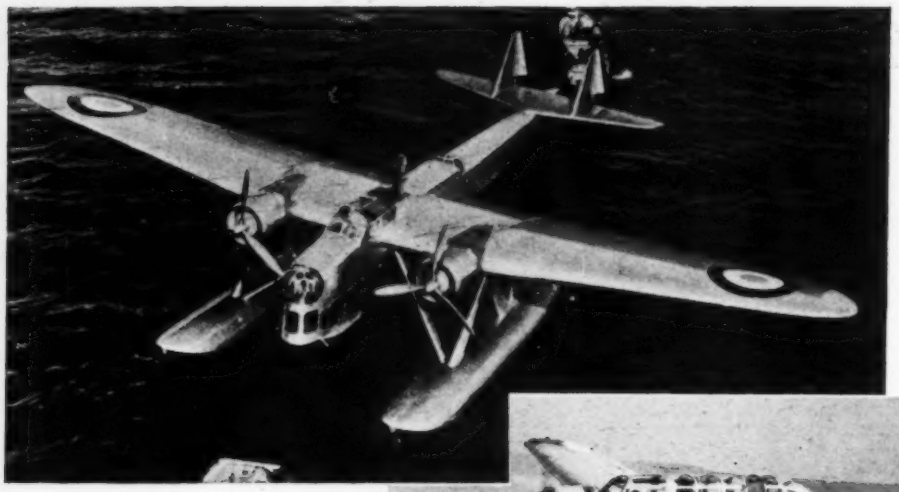
It may be significant that France has placed an order for the Latécoère 298 floatplane with a single 860 h.p. Hispano-Suiza engine. This machine carries one internally stowed torpedo.

Steep dive bombing (a method of attack which can be used to particular advantage against shipping) will impose limits on size and will influence structural design, though practically any normal type of twin-engined bomber to-day is capable of what the French call *bombardement en semi-piqué*, i.e., releasing the bombs in a comparatively shallow dive.

Design requirements for over-water coastal-defence

The torpedo on a German Arado Ar. 95, a particularly versatile biplane, with B.M.W. radial engine.

Another German torpedo-carrier is the Dornier Do. 22 parasol monoplane, seen fitted with an Hispano-Suiza engine.



(Left) The French Amiot 150 is a heavy torpedo - bomber-reconnaissance float plane.

(Below) Fokker's latest creation—the T.8-W floatplane which can carry an internally stowed torpedo.

aircraft are range, good vision for crew, ability to make a safe landing on the sea and to float for an extended period. Retractable undercarriages will, of course, permit safer alighting characteristics than will fixed gear. In such machines (more perhaps than in any other military type) comfort is a prime necessity. Provision must be made for sea-marking devices, flares and a selection of nautical equipment. The wireless installation could be of the most advanced nature.

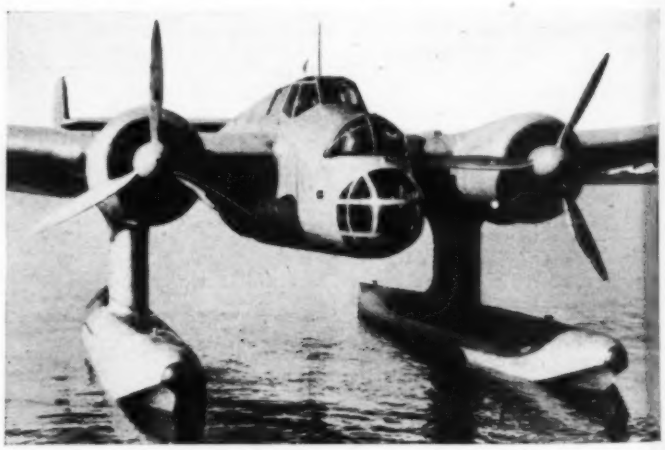
It may be that for fleet shadowing, local patrol and anti-submarine convoy work a specialised type would be warranted—a machine which could fly much more slowly than the higher-powered defensive types now in use. For fleet-shadowing missions it might be advisable to cut down armament to a minimum or even to eliminate it altogether, making it possible to fit silencing arrangements. Armament of coastal-defence machines will, in the main, correspond with those of comparable over-land aircraft. The former types, however, will possess an important advantage in that they will be able, when attacked, to fly very low over the water, thereby handicapping attacking fighters, which would in any case not be able to benefit from the full power of their supercharged engines.

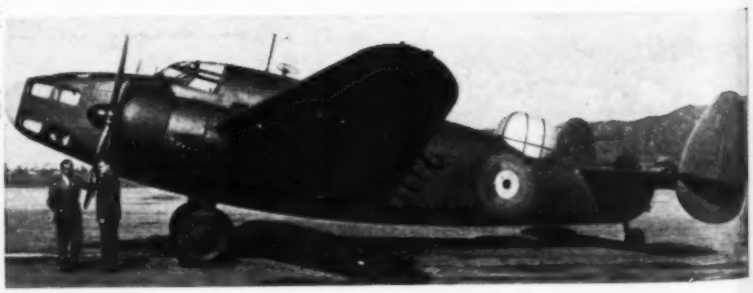
Spotting for coast-defence guns is a duty which can be discharged by less specialised machines than those already discussed.

The shell-gun will doubtless be fostered for use against surface craft. In this connection it is of interest to recall the 37 mm. "cow" (Coventry Ordnance Works) guns at one time installed in the Blackburn Perth flying boats. Such a weapon could make things particularly unpleasant for a submarine or small merchant ship. It should also be possible, using special ammunition, to damage the upper works of the smaller types of warships such as might be met in home waters and to impair their fighting efficiency quite seriously.

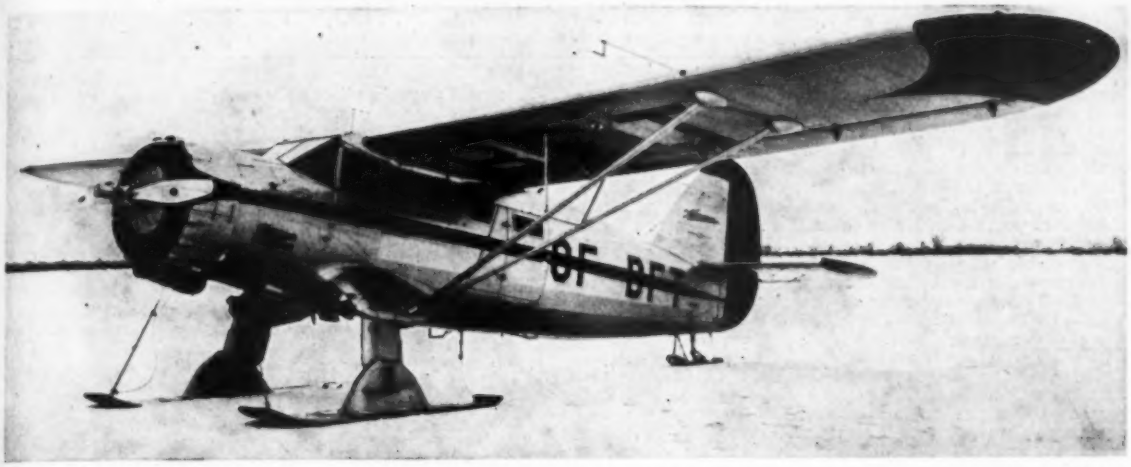
The use of small non-rigid or semi-rigid airships has frequently been suggested for general convoy and patrol work; the success during the Great War of the "blimps" used for this purpose is a good argument in their favour, and the development of such craft in a small way is still being undertaken in certain countries, notably America.

Amphibian aircraft are not normally justified for specialised coastal defence work as the land undercarriage inevitably detracts from range and useful load.





A particularly neat float undercarriage characterises the Blohm and Voss Ha 140 coastal defence torpedo carrier. Below it is the Lockheed Hudson adopted by the R.A.F. for reconnaissance and bombing operations.



THE LATEST NOORDUYN : A 1939 model Norseman which has recently been delivered to Hudson Bay Air Transport. This machine has full blind-flying equipment and Marconi two-way radio. The skis have M. and C. shock absorbing pedestals, and special Noorduyn skis which are shod and edged with Bakelite.

HERE and THERE

King's Cup Preliminary Regulations

THE Royal Aero Club has now issued preliminary regulations for the King's Cup Race, which has been provisionally fixed for September 2 or 9 at the new Birmingham municipal airport.

(1) *Qualifications of Competitors and Pilots.*—(a) Competitors: The entrant, the pilot or pilots, or other operation personnel, and any passenger or passengers carried in the Race must be British subjects. The entrant must be an individual and not a firm or company. (b) Pilots: The pilots taking part must have had at least 100 hours' experience in solo flying prior to the start of the Race, and must be prepared to produce evidence to this effect if called for.

(2) *Aircraft.*—The Race is open to any type of *bona fide* civil aircraft, provided that the aircraft, including the engine and the accessories, has been entirely constructed in the British Empire. For the purpose of this rule, a *bona fide* civil aircraft shall be deemed to be one which was originally designed and subsequently constructed for use in civil aviation activities.

(3) *Eligibility.*—In any question regarding the eligibility of any entrant, pilot or aircraft under the rules the decision of the Royal Aero Club shall be final.

(4) *Course.*—The Race to be flown over a total distance of 400 miles, consisting of four sections of 100 miles each. Each section to consist of five laps of a 20-mile circuit.

(5) *Handicapping.*—The minimum handicap speed will be 140 m.p.h. For the first section the aircraft will be handicapped on estimated performance. For the ensuing sections they will be re-handicapped; for the second section in accordance with their performance in the first section, and for the following sections according to the best performance in any previous section. The minimum handicap speed rule will be applied, however, in re-handicapping the various sections. Any aircraft showing an increase of average speed for a section of more than 5 miles per hour over a previous speed in a section will be penalised to the extent of one point for each 1 mile per hour over the 5 m.p.h. In applying this rule circumstances outside the control of the pilot, such as variation of weather conditions, may be taken into account.

(6) *Awarding of Points.*—Points to be awarded to the first five competitors in each section as follows:—

1st: Five points.	4th: Two points.
2nd: Four points.	5th: One point.
3rd: Three points.	

(7) *Winner.*—The winner to be the competitor who, having completed the course in accordance with the rules, has gained the highest number of points.

(8) *Entrance Fee.*—The entrance fee will be £10.

(9) *Prizes.*—

1st:	£500
2nd:	£200
3rd:	£100
Fastest Time:	£100
Section Prizes:	£100 (divided into 4 prizes of £25 each for the winner of each of the 4 sections)
	£1,000

German Bomber Record

ONE more international record has gone to Germany. A new Junkers bomber, piloted by the Junkers pilots, Ernst Seibert and Kurt Heintz, flew from the works aerodrome at Dessau to the Zugspitze and back, a distance of 621.37 miles, in 116 minutes with a useful load of 2,000 kg. (4,410 lb.). This represented an average speed of 321.25 m.p.h. The flight has been submitted to the F.A.I. for homologation.

This particular Junkers is an all-metal low-wing monoplane fitted with two Junkers Jumo 211 engines (a development of the Jumo 210). The engines drive Junkers constant-speed airscrews, so that the record flight can be said to have been an all-Junkers affair.

Both pilots belong to the makers' experimental department. Ernst Seibert, who is 27, began his flying career as a glider pilot, and afterwards took his ticket at Darmstadt. After serving in the German air force, he joined the Junkers company in 1937 as test pilot. Kurt Heintz, who was second pilot on the record flight, is 30 and was once upon a time chief of the Danzig Akaflieg. After a period as lecturer at the Charlottenburg Technical Institute he joined Junkers in 1938.

The record flight is of considerable military significance, in that it shows that the new Junkers bomber would probably have a range of more than 1,000 miles at a cruising speed of not much less than 300 m.p.h. while carrying a ton of bombs.

New C.A.G. Trainer: The Latest Hillson

SOMETHING rather different in light machines will shortly be appearing from the Hillson works in Manchester. For some time Mr. Norman Sykes, the company's designer, has been at work on a specialised trainer, and this machine is now taking shape and should be flying within the next two months or so.

Although primarily designed for club and C.A.G. work, the Helvellyn, as the machine is known, is likely to have an all-round performance which will make it suitable for other purposes. Basically, the machine is a tandem-seater, mid-wing monoplane with ample power, and considerable efforts have been made in the course of design work to ensure that all the working details are both accessible and robust, and the machine is built in units for export convenience.

As will be remembered, the firm was previously responsible for the manufacture of Praga Baby monoplanes in this country, and the good stalling and general characteristics of these machines are being retained in the Helvellyn by the use of the same wing section and by arranging the tail unit in a similar relative position. In fact, it is not expected that spinning will be possible, and for training in this manœuvre a larger rudder will be offered for temporary use.

Structurally the Helvellyn is fairly straightforward, though compressed wood is used. The main spar, for instance, is a built-up member with compressed wood stiffening for a plain

HERE AND THERE (CONTINUED)

spruce centre. Over a few feet at each wing-tip the spar is without the stiffening, so that any damage at this point can easily be repaired by splicing. The robust centre section of this spar is carried between two fuselage bulkheads, while the rear spar is similarly mounted. Aft of the girder-braced forward section the rest of the fuselage is a plywood box.

The object in laying out the machine as a mid-wing monoplane is to provide, as far as possible, the advantages both of the high-wing and low-wing type. With this arrangement the low-wing range of view is available, while most of the stability characteristics of the high-wing machines are retained. In its prototype form the Helvellyn will be fitted with a conventional undercarriage, but the fuselage members are so spaced that it will be a simple matter to move the whole undercarriage rearwards and to fit a nose-wheel, for which provision has been made in the forward structure. The engine will be a Cirrus Minor of 80-90 h.p., and it is estimated that the maximum speed will be 127 m.p.h. and the normal cruising speed 110 m.p.h. With the split flaps down, the stalling speed will be in the region of 45 m.p.h.

Other essential figures are: Span, 33ft.; length, 22ft.; weight empty, 895 lb.; all-up weight (fully aerobatic), 1,500 lb.; wing loading, 9.6 lb. per sq. ft.; initial climb, 750ft. per min.; service ceiling, 13,000ft.; and range at cruising speed, 660 miles.

Meanwhile considerable developments and extensions are being made in the airscrew section of the Hillson factory, where work is being carried out under Jablonsky patents. One of the latest ideas in this section is the application of one-piece brass leading edges. Brass strips are attached to each side of the leading edge, and the one-piece cover is simply sweated on to these strips. Nowadays, of course, with the greater use of constant-speed and other hubs, there is a growing demand for single blades with very specially strengthened roots. The difficulty is to make this comparatively small-diameter root strong enough in such a way that it can be firmly fitted into the hub. The increased knowledge of the capabilities of special types of "artificial" wood is now making things easier for the airscrew designer.

Direct Club Subsidy in India

AFTER the end of this month the scheme for the granting of subsidies to the Indian flying clubs, which has been in action for three years, will no longer be operative. The Government of India has, however, decided to renew the grants for a further period of three years with special conditions designed to improve the financial positions of the clubs and to reduce the cost of flying.

For a start, seven fully equipped D.H. Tiger Moths will be purchased and loaned to the seven subsidised clubs. A portion of the bonus grants which have hitherto been paid direct to the clubs will, in future, be paid to the pilots and the maximum grants which may be earned by each club will be increased from Rs.20,000 to Rs.25,000. The fixed annual subsidy will be dependent on the number of types of machines maintained by the clubs. The machines will be divided into three classes, depending on the power and obsolescence or otherwise of the machines. These classes will be designated "A," "B" and "C," the last comprising the types which are generally known as the ultra-lights. The bonus rates will remain unchanged, but of the Rs.300 for each *ab initio* "A," Rs.100 will go to the pilot, while of the Rs.100 for each renewal a sum of Rs.50 will go to the pilot.

It is reasonably supposed that the loss to the flying clubs by the payment of part of the bonuses to the pilots themselves will be more than set off by the increase in fixed subsidy and by the resultant increase in the number of pilots being trained.

Another Australian Factory

THE CLYDE ENGINEERING CO., LTD., one of the largest machinery factories in Sydney, has announced its intention of erecting a factory for the construction of military and civil aeroplanes and has signed an agreement with the Aircraft Development Pty., Ltd., which represents in Australia the interests of the Armstrong Siddeley Motors, Ltd., Airspeed (1934), Ltd., Phillips and Powis Aircraft Co. and the Heston Aircraft Co. These four companies will grant licences to the Clyde Engineering Co., Ltd., for the erection of various types of machines in the latter's own aircraft division. Various other Australian companies, which produce precision apparatus, have offered their support. A special test aerodrome will also be laid out.

In the last ten years, the Clyde Engineering Company has produced many types of transport material, including locomotives, railway carriages and other rolling stock, tramcars, engines and bridges. The general director of the company is Mr. H. P. Weymouth. The chairman of the Aircraft Development Pty., Ltd., is Mr. Stuart F. Doyle. To date, the only Australian aircraft construction company has been the Commonwealth Aircraft Corporation, Ltd., of Fishermen's Bend near Melbourne.

New Club Near London

A NEW flying club has been formed on the outskirts of South-East London, its aerodrome lying within 17 miles of Charing Cross.

Though its name—the Horton Kirby Flying Club—suggests the moors of Yorkshire or the Lakeland Fells, it is actually called after the nearby village of Horton Kirby, which lies to the east of the Dartford-Farningham road, at a point south of Farningham Road station. By road, the aerodrome can best be reached via the main London-Maidstone Road, turning left after passing the Farningham Hotel on the Farningham By-pass.

The club possesses a fleet of nine training aircraft, including six Gipsy 1 Moths, one B.A. Swallow with a Cirrus Minor engine and two Cirrus-engined Avians.

Mr. G. W. Alexander, who was chief pilot of Air Dispatch, Ltd., is the chief instructor. His right-hand man is Flt. Lt. P. de C. Festing-Smith, and there are three assistant instructors. The fee for full membership is two guineas, with an entrance fee of one guinea. Associate members will pay one guinea per annum, with no entrance fee. The flying rates are as follows: Solo, 30s. per hour; dual, £2; blind flying, £2 10s.; for C.A.G. members a subscription of 2s. 6d. will be charged, while 5s. per hour will be the rates for both dual and solo flying. Full courses for "B" licences can be arranged at an inclusive charge or on contract rates.

While large numbers of C.A.G. members have already joined the club, there are still vacancies for those living in or near South-east London. Further details are obtainable from the secretary, Mr. D. S. Alexander, of the Aerodrome, Horton Kirby, near Dartford, Kent.

Forthcoming Events

APRIL.

Sat.,	15th.	Opening of West Hartlepool Airport by the Secretary of State for Air.
Thurs.,	20th.	R.Ae.S. Lecture*: "Possible Steel Developments," by Dr. T. Swinden, F.R.Ae.S.
Fri.,	21st.	Norfolk and Norwich Aero Club: Annual Dinner and Dance.
Sat.	22nd.	Aero Golfing Society: Match v. R.A.F. Martlesham and Felixstowe.

MAY.

Thurs.	4th.	R.Ae.S. Lecture*: "Strength of Thin Metal Construction," by H. L. Cox.
Sun.	14th	R.Ae.S. Garden Party, Faireys' Great West Aerodrome.
Tues.,	16th	Aero Golfing Society "Flight" Trophy, Wentworth.
Sat.,	20th.	Empire Air Day.
Thurs.	25th.	R.Ae.S. Wilbur Wright Memorial Lecture by Dr. G. W. Lewis.
Sat.,	27th.	London-I.O.M. Race.
Mon.,	29th.	Manx Air Derby and Tynwald Race.

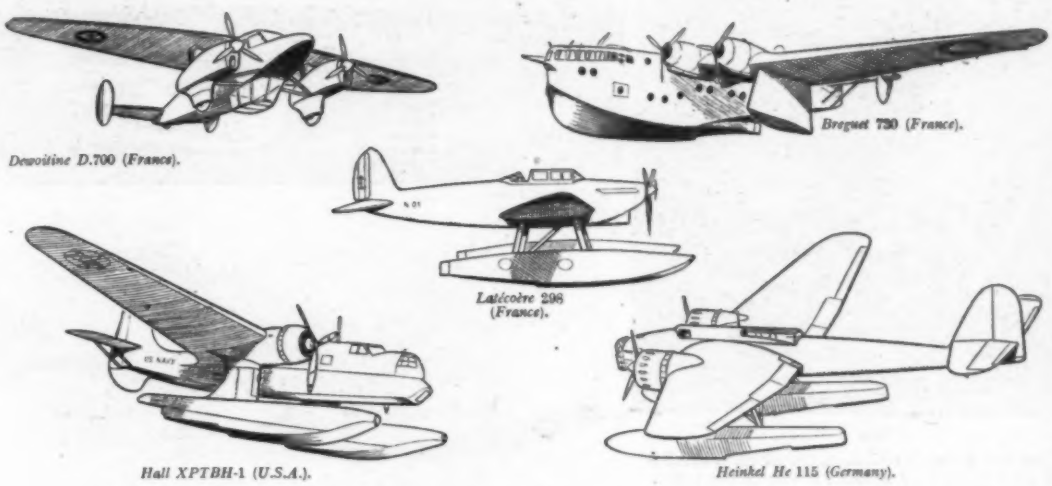
JUNE.

Sat.,	10th.	Brooklands Flying Club "At Home."
Sat.,	17th.	Official opening of Derby Municipal Airport (Burnaston) by Sir Kingsley Wood.
Wed.,	21st.	Aero Golfing Society: Jubilee Cup, Berkshire Golf Club.
Sat.	24th.	Royal Air Force Garden Party.

JULY.

Sat.,	8th.	Official Opening of Birmingham Airport (Elmdon) by H.R.H. the Duchess of Kent.
Sat.,	8th-Sun. 23rd.	Brussels Aero Show.
Sat.,	15th.	Gosport Reunion, Brooklands.
Sat.,	29th-Sun. 30th.	Frankfurt International Flying Meeting.

* All these lectures take place at 6.30 p.m. at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.



A selection of foreign types suitable for coastal and open sea work.

"Flight" photograph.

The magnificent Short Sunderland (four Bristol Pegasus XXII) now equipping certain R.A.F. units.

Military Aircraft—IX

FLYING BOATS

FOR the time being the flying-boat strength of the Royal Air Force is composed, broadly speaking, of two varieties of aircraft: obsolescent twin-engined biplanes and highly developed four-engined monoplanes (Short Sunderland), the latter comparing favourably in many respects with certain prototypes which have not yet gone into service abroad. It is reasonable to suppose that twin-engined monoplane boats will, before long, appear in R.A.F. squadrons. The commodious long-range service flying-boat of to-day is virtually a self-contained unit and, as such, fulfils a vital function in Empire defence. According to the claims of at least one big manufacturer of long-range marine craft, the flying-boat should supersede the landplane as a bomber, first because with equal power it can carry a bigger load for a greater distance than a landplane (assuming that recourse is not made to assisted take-off) and secondly because its "aerodrome" is indestructible and self-levelling. It may be argued that this is an over-statement of the case, though the usefulness of the flying-boat as a long-range weapon or for patrol and reconnaissance is not to be questioned. America, even more, perhaps, than ourselves, has realised its worth, as witness her superb fleet of over two hundred Consolidated PBY patrol-bomber monoplanes.

Reconnaissance, patrol and bombing (and in some instances, torpedo-dropping) would be the primary war-time duties of the long-range flying-boat, while in peace time it can do a tremendous amount of good work by "showing the flag" in out-of-the-way parts of the world.

In many respects the design of military flying boats (the term "naval" would be more explicit, though hardly accurate) is ahead of civil practice, though our Short Sunderland, be it said, is nothing more or less than a developed and militarised version of the Empire boat. Inevitably there is a close affinity between Service and civil boats for, unlike the landplane bomber, the military flying-boat has a really spacious interior and may, generally speaking, form the basis of a first-rate civil craft. Already a commercial version of the big Consolidated XPB 2Y-1 has been planned for trans-oceanic service.

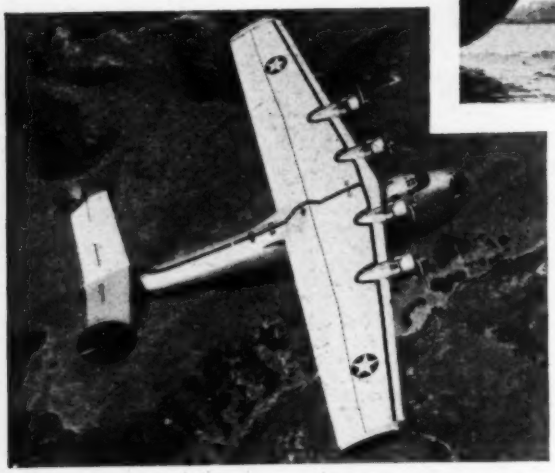
Advanced Design

Design features of recent military flying-boats include two decks; retractable floats (Consolidated and Latécoère); Diesel engines (Dornier); and powered multi-gun turrets in bow and stern (Short, Consolidated and Sikorsky). Craft such as those mentioned have facilities for cooking, repair and even recreation, while there is sleeping accommodation for officers and crew. Independent electric generating systems, intercommunication "exchanges," sound-proofing and elaborate heating and ventilating systems are also coming into vogue.

In seaworthiness the flying-boat scores over the big coastal defence floatplane, though it must be out of service longer for hull inspection, whereas the floatplane can have its under-

An American prototype with a fine background — the Sikorsky XPBS-1 (four Twin Wasps).

Top left is the Consolidated model 28, generally similar to the PBY series of the American Navy. On the right, reading from top to bottom, are the Dornier Do.24, as supplied to the Governments of Germany and the Netherlands; the Blohm and Voss BV 138, and France's new Latécoère with Gnome-Rhône 14 No engines and retractable outboard floats. Below is another interesting American prototype, the Consolidated XPB2Y-1 with four Pratt and Whitney Twin Wasps.



carriage changed quite rapidly and can soon be replaced in service, effecting, it is claimed, important economies.

Bomb loading is something of a problem, owing to the height of the wing of a typical modern monoplane boat. It is possible, of course, to stow the bombs in the hull and to slide them outboard either within the wing structure itself or beneath the wing.

Present practice in the fitting of guns to large flying-boats includes the provision of nose and tail turrets, midship positions (which are usually of the screened, manually worked variety) and sometimes a lower machine-gun post in the bottom of the hull aft of the rear step. The size of the bow turret in the Consolidated XPB2Y-1 suggests the installation of shell-firing armament. The Short Sunderland, for the time being at least, depends on multiple machine guns in Nash and Thompson turrets.

In all probability the flying-boat will remain the largest and most powerful machine of any air force. Accordingly, it is likely that these craft will first demonstrate buried engine installations within their monoplane wings; practical facilities for attention to the engines in flight; free guns mounted outboard of the fuselage, and the installation of weapons of 75 mm. bore.

Their great size suggests possibilities for large-scale troop-carrying and the rapid reinforcement of isolated posts.

AIR MINISTER AT THE CHELSEA COLLEGE

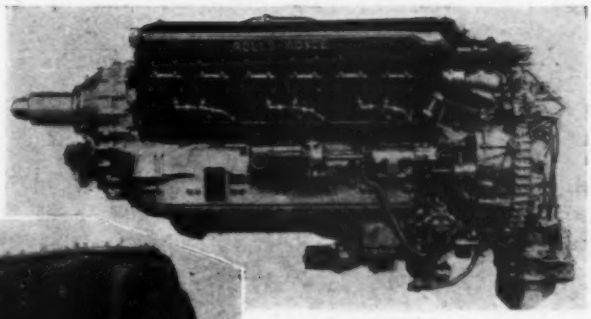
EARLY last week Sir Kingsley Wood, Secretary of State for Air, paid his first official visit to the College of Aeronautical Engineering at Chelsea. Originally he was to have made this visit last October, but urgent business of State on that occasion prevented him from attending. Instead, his Parliamentary Private Secretary, Sir Edward T. Campbell, M.P., understudied him.

This time Sir Kingsley Wood saw for himself how the College carries out the curriculum whereby some 300 students are instructed in every phase of aircraft production. In company with Lord Wakefield, President of the College, and Mr. C. H. Roberts, the Principal, he was shown the very complete machine and woodwork shops, drawing office, and foundry, where a mould of Sir Kingsley Wood's name was filled in his honour.

In the aero-engine shop he was shown how the students assemble the wide range of engines prior to testing them down at Brooklands (after which, incidentally, they dismantle them once more). Upstairs he saw how students are taught, in the practical sense, the intricacies of aircraft electrical equipment and its maintenance. In fact, the tradition of the College is to ensure that the lecture part of the curriculum is supplementary to the practical work, so that the student shall not only be able to pass his examinations, but shall also be capable of actually doing the work about which he is questioned.

Before leaving, Sir Kingsley Wood briefly addressed the students, emphasising the importance of the Royal Air Force in the country's defence. He hoped to be able to devote, in the near future, more of his time to the sphere of civil flying.

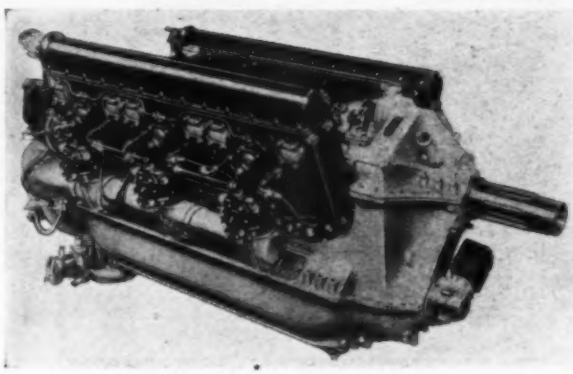
Engine Development Outlined : Modern Practice and Probable Tendencies



The installation of the two-speed supercharger is apparent in this view of the Rolls-Royce Merlin X (1,160 h.p. at 16,730ft.)

The Daimler Benz DB 600 (lower left) is extensively used in the German Luftwaffe to power high-speed fighters and bombers.

MILITARY POWER



France's most succeseful high-powered liquid-cooled unit is the Hispano Suiza 12. A shell-gun may be installed to fire through the airscrew shaft.

AS the most powerful aero engine yet installed experimentally in a military machine is probably giving rather more than 1,700 h.p. and the smallest unit used for military training is rated at about 80 h.p., it will be gathered that a detailed study of military power plants is quite out of the scope of these notes. In the circumstances, it will be advisable to touch on each class of military machine and to refer briefly to power plant requirements and likely departures in design.

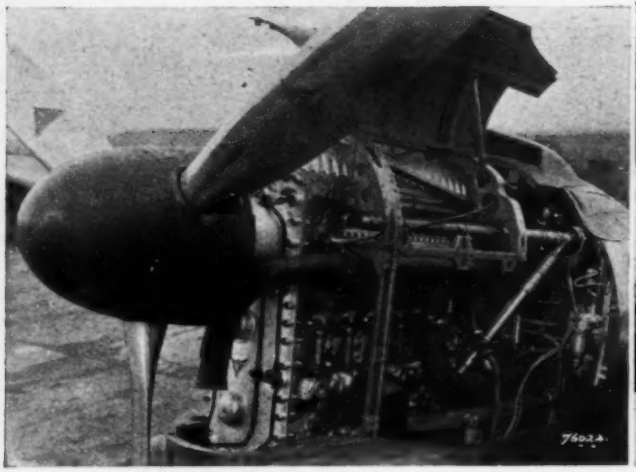
For training there is a demand for small four- and six-cylinder air-cooled in-line units (as typified by the De Havilland and Cirrus products) and for radials, perhaps the most successful British engine of this type being the Siddeley Cheetah of about 350 h.p. Primary requirements are reliability and ease of maintenance. The higher-powered trainers are suited to take such units as the Alvis Leonides, Pratt and Whitney Wasp, Wright Whirlwind and even, in the instance of the Miles Master, the Rolls-Royce Kestrel liquid-cooled model. Incidentally, the Kestrel XXX, as fitted in the Master, is a de-rated adaptation of a fully supercharged Kestrel type formerly used in first-line aircraft, thus exemplifying the possibilities of using up obsolescent or surplus power plant in training machines.

Although, as has been demonstrated in the foregoing articles in this issue, a number of modern military types use engines of comparatively low power, it is the larger units which hold the field.

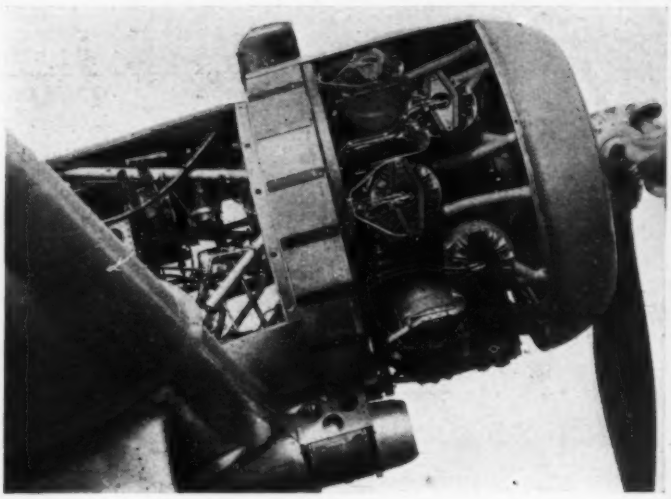
Almost without exception, these are supercharged models, the degree of supercharge being dependent on the duties for which the aircraft is intended. Army co-operation machines, attack aircraft, flying boats and certain other types are normally fitted with medium-supercharged units delivering their maximum power at 5,000-7,000ft., though specialised fighters and bombers, in which performance and altitude is a consideration of the first importance, demand engines which produce their best output (disregarding the take-off period) at heights between 10,000 and 18,000ft.

The introduction of the two-speed supercharger overcomes one of the main disadvantages of the latter type, i.e., comparatively poor performance near the ground. Although commonly of the gear-driven type, superchargers can be worked by the exhaust gases of the engine, and this variety is being intensively developed in America. On at least one Russian bombing machine, one engine of 860 h.p. is fitted to drive the superchargers of the four 1,000 h.p. units which provide the motive power.

The Ju. 87 dive-bomber is one of the new German Service machines using the Junkers Jumo 211 inverted vee-twelve liquid-cooled engine.



A Junkers Jumo 205 Diesel in a Ju.86K. (Top right) The pilots who (as reported on page 333) broke a speed-with-load record with a Junkers bomber with Jumo 211's having the gilled nose radiators illustrated.



A test installation of a Bristol Hercules 14-cylinder, two-row sleeve-valve engine.

According to present indications, air cooling and liquid cooling are likely to be "in the ring" for many years to come, though extremely high speed (in orthodox aircraft at least) tends to demand the latter type, in which cooling drag can be reduced to an extremely low figure. The ducted radiators now coming into use may, in fact, exert a mild propulsive thrust.

Although high-powered air-cooled engines are normally of the radial type, the Napier company have met with great success in the production of high-speed engines with a large number of small cylinders arranged in four banks in the form of an "H." A high-powered unit in this form, cooled either by air or liquid, and possibly placed on its side, suggests great potentialities when used in multi-engined machines. The "X"-shaped engine, a number of examples of which have appeared over a period of years, may also take the stage once more.

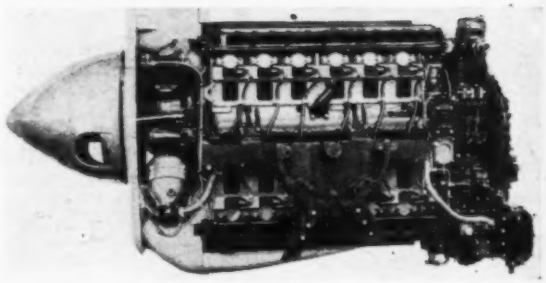
When installed in single-engined machines, engines of over 1,500 h.p. may demand twin concentric airscrews to reduce torque reaction and the use of an unduly "stilty" undercarriage.

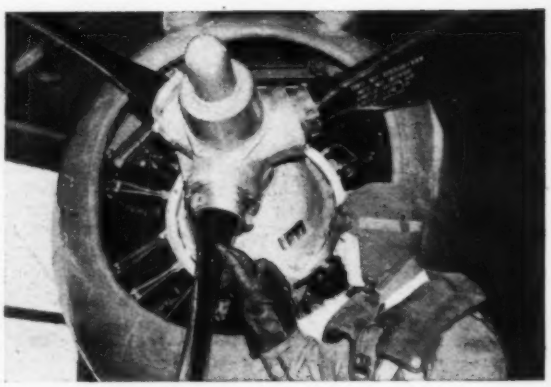
Military aircraft are usually the first to derive advantages from innovations making for improved performance. Already a number of the German military engines are operating on a direct-injection principle, while certain long-range types are powered with heavy-oil engines of Junkers manufacture. It may be that these diesel engines were installed not primarily to improve range, but to alleviate the demands on the supply of high-octane petrol in war time.

Improvement in performance does not necessarily mean increased complication, as witness the unique Bristol sleeve-valve aero engines. This elaboration arises rather from incidental sources, e.g., accessories and v.p.-airscrew mechanism

It is not surprising, therefore, that in certain multi-engined installations the accessories are being driven by a separate small power plant.

The possibility of rapid interchangeability of engines demands very close study, and most of the big engine manufacturers are now giving special thought to the subject. Perhaps the greatest success has so far been achieved by the German Junkers concern.





Twenty-four small air-cooled cylinders distinguish the Napier Dagger VIII (upper right). Below is the installation of a constant-speed fully-feathering airscrew on a Twin Wasp. This device keeps down engine speed in a dive.